Postprint: Formation and Corrosion Resistance of U-Co System Amorphous Alloys

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Date: 2016-11-10T00:00:00+00:00

Abstract

The U-rich alloys UxCo100-x (x = 50~87.5, atomic fraction, hereinafter the same) in the U-Co binary system were investigated. Master alloy ingots and ribbon samples were prepared by arc melting and melt spinning. The phase composition and stability of the alloy samples were studied by X-ray diffraction and differential scanning calorimetry, while the corrosion resistance of the amorphous alloys was examined using potentiodynamic polarization. The results show that the composition range for amorphous ribbon formation is 58.5? x ?78, with the optimal composition appearing near U66.7Co33.3; at a heating rate of 20 K/min, the crystallization temperature of U-Co amorphous alloys ranges from 534~550 K, the crystallization exothermic enthalpy is 4.8~7.9 kJ/mol, and the reduced crystallization temperature Trx value reaches up to 0.535; in a 50 x 10-6 Cl- solution, the corrosion potential of U-Co amorphous alloys is mostly close to -50 mV, their corrosion resistance is significantly superior to that of depleted uranium, and the corrosion resistance of U-Co amorphous alloys shows a positive correlation with their glass-forming ability.

Full Text

ACTA METALLURGICA SINICA
Vol. 51, No. 5, May 2015, pp. 623-630

Study on Formation and Corrosion Resistance of Amorphous Alloy in U-Co System

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Supported by National Defense Basic Scientific Research Program of China (No. B1520133007) and Scientific and Technological Development Foundation of China Academy of Engineering Physics (No. 2013A0301015)

Manuscript received 2014-10-27, in revised form 2015-02-02

Abstract

The formation of amorphous phase has been investigated in the U-Co system over a wide composition range of UxCo100-x (x=50~87.5) by means of melt-spinning. Phase identification for the arc-melted ingots and rapidly quenched alloys, as well as the thermal stability of the amorphous phases thus formed, have been examined by XRD and DSC, respectively. Rapid quenching experiments revealed that the ease of amorphous phase formation occurred within the composition range of 58.5–78 at% U, and the amorphous phase was most readily formed in the vicinity of U66.7Co33.3. The dynamic crystallization temperatures of the amorphous phases were determined to be 534~550 K at a DSC heating rate of 20 K/min, with the highest reduced crystallization temperature (relative to the liquidus temperature) calculated to be 0.535. Moreover, the exothermal enthalpies of crystallization were determined to be in the range of 4.8~8.5 kJ/mol. Upon room-temperature electrochemical polarization in a 50$×10^{-6}$ Cl⁻ electrolyte, these amorphous alloys exhibited corrosion potentials as high as about -50 mV, being much more positive than that of depleted uranium. In these amorphous alloys, it has also been found that the corrosion resistance performance appears to be parallel to the ease of amorphous phase formation.

KEY WORDS amorphous alloy, uranium alloy, rapid solidification, corrosion resistance

Uranium alloys have important applications in the nuclear field. However, the corrosion problem is one of the key factors affecting their engineering applications, as current uranium alloys have crystalline structures. Amorphous alloys typically exhibit good corrosion resistance due to their characteristics of single-phase structure, compositional uniformity, and lack of defects such as dislocations and grain boundaries. Developing new uranium-based amorphous alloys with good corrosion resistance is expected to expand the applications of uranium alloys.

Uranium alloys have high chemical reactivity, radioactivity, and certain chemical toxicity, making their preparation processes complex and difficult. Moreover, phase diagram and thermodynamic data for uranium alloys are very scarce, which has restricted systematic studies on the glass formation, thermal stability, and properties of uranium-based amorphous alloys. In 1969, Bethune obtained amorphous phases in the U-Si system through irradiation. Subsequently, Giessen and Elliott prepared and studied amorphous U-M (M=Fe, Mn, Co, Ni, Cr, V, Si, Os, Ir, Pd) alloys using the Duwez gun and hammer-anvil methods. Reference [16] reported preliminary results on the thermal stability of U-M amorphous alloys but did not provide specific DSC curves. Notably, the XRD pattern of U67Fe33 presented in that work contained three diffuse diffraction peaks of varying intensities. Reference [17] reported XRD patterns for rapidly quenched U85.7Fe14.3 samples, where the first and second strongest diffraction peaks were very sharp. Comparing DSC data for samples prepared by irradiation, melt quenching plus irradiation, and melt quenching alone revealed that the crystallization enthalpy of the melt-quenched sample was significantly smaller than the other two. Without microstructural observation evidence, whether the U85.7Fe14.3 melt-quenched sample had a purely amorphous structure remains questionable. It should be noted that the melt-quenched samples prepared in reference [16] were fragmentary with very non-uniform quality, affecting subsequent structural and property characterization. In 1985, Drehman and Poon first prepared U-Co, U-Fe, and U-Ni amorphous ribbons using the melt-spinning method and provided XRD patterns for U85.7Co14.3 samples and DSC curves for U72Co28. The XRD pattern of U85.7Co14.3 also contained three diffuse peaks, and the DSC curve of U72Co28 showed sharp crystallization exothermic peaks in the 275~285 K temperature range. In 1987, Nastasi and Parkin obtained rapidly quenched U6Fe alloys using the hammer-anvil method and studied the effect of amorphous phase content on crystallization kinetics, finding that crystallization temperature increased with increasing amorphous phase content. In summary, previous research on uranium-based amorphous alloys has been very limited, particularly lacking systematic studies on glass formation, thermal stability, and corrosion resistance for specific systems.

This study selected the U-Co system and systematically investigated the composition dependence of amorphous formation, thermal stability, and corrosion resistance by preparing ribbon samples over a wide composition range of UxCo100-x (x=50.0~87.5 at%) using rapid quenching, combined with XRD, DSC, and electrochemical analysis techniques.

1. Experimental Methods

The alloy compositions investigated in this study ranged from UxCo100-x (x=50~87.5). Based on the characteristics of the U-Co binary phase diagram, four compositions (U87.5Co12.5, U85.7Co14.3, U83.3Co16.7, and U78Co22) were selected near the U-rich U6Co phase; six compositions (U58.5Co41.5, U62.5Co37.5, U65Co35, U66.7Co33.3, U69.2Co30.8, and U72Co28) were chosen near the deep eutectic point U62.5Co37.5; and two compositions (U55Co45 and U50Co50) were selected near the UCo phase. The experiments used low-carbon depleted uranium with purity of about 99.5% (with U-C compounds as the main impurity) and Co with purity >99.9%. After batching according to the respective compositions, master alloy ingots of about 10 g were prepared using an NMS-II-type metastable alloy preparation furnace under high-purity Ar gas (purity >99.999%). To ensure compositional homogeneity, the master ingots were remelted four times. The master alloys were then crushed for rapid quenching by melt-spinning. The copper roller (260 mm diameter, 50 mm width) had a rotation frequency of 0~100 Hz, and a linear velocity of 50 m/s was selected. The cooling water flow rate was about 150 mL/s, and the pressure difference of the top-blown gas was approximately 0.04 MPa. The obtained U-Co amorphous ribbons were about 1 mm wide and 20 m thick, continuous and uniform, straight without burrs, with bright surfaces. During experiments, ribbon samples containing amorphous phases could be bent 180° without fracture. [Figure 1: see original paper] shows optical photographs of the amorphous ribbon samples, including images bent into V and W shapes.

Phase compositions of the U-Co alloy master ingots and ribbons were analyzed using an EMPYREAN X-ray diffractometer (Cu Kα) with a 2 scanning range of 20°~100°. Thermal stability of the ribbon alloys was tested using an STA-409CD DSC with a heating range from room temperature to 1273 K at a heating rate of 20 K/min. The corrosion resistance of U-Co amorphous alloys was evaluated using potentiodynamic polarization. The polarization tests were conducted on a PARSTAT 2263 electrochemical workstation with the amorphous alloy as the working electrode, saturated calomel electrode as the reference electrode, and Pt wire as the auxiliary electrode. The corrosion medium was a 50$×10^{-6}$ Cl^- solution at room temperature. The potentiodynamic polarization scan rate was 1 mV/s, with a polarization range from -250 mV (relative to open-circuit potential) to the pitting potential. If no pitting potential appeared, the test was stopped at 300 mV (relative to open-circuit potential).

2. Results and Discussion

2.1.1 Phase Composition of Master Alloy Samples

[Figure 2: see original paper] presents the XRD patterns of UxCo100-x (x=50~87.5) master alloys. As shown, alloys with x=50, 55, 58.5, 62.5, 65, 66.7, 69.2, 72, 78, and 83.3 all consist of a two-phase mixture of body-centered tetragonal (bct) U6Co phase and body-centered cubic (bcc) UCo phase. These two phases have relatively large numbers of atoms in their unit cells, with complex atomic occupancy in the U6Co phase. Table 1 lists the measured lattice parameters of each phase in different samples, where the U6Co phase has a=1.0266~1.0483 nm, c=0.5123~0.5276 nm, and the UCo phase has a=0.6317~0.6428 nm. These values are close to the reported lattice parameters of U6Co (a=1.03600 nm, c=0.52100 nm) and UCo (a=0.63557 nm) phases in the literature. From [Figure 2: see original paper] and Table 1, it can be seen that as the U content increases, the diffraction peak positions and lattice parameters of the U6Co and UCo phases show no systematic variation trend. This indicates that in the slowly solidified master alloy ingots, the actual compositions of both U6Co and UCo phases deviate from their strict stoichiometric ratios. Additionally, the relative intensities of diffraction peaks for these alloy phases are not completely consistent with standard powder patterns, reflecting a certain degree of crystallographic preferred orientation in their grains. For example, in the as-cast alloy with x=62.5, the preferred orientation of the (200) crystal plane is relatively strong. For alloys with x=85.7 and 87.5, the diffraction peaks of the UCo phase basically disappear in the XRD patterns, leaving mainly the U6Co phase, whose lattice parameters are also given in Table 1. In summary, the phase composition of U-Co master alloys formed by slow cooling in a copper crucible is basically consistent with the phase composition at each composition in the thermodynamic equilibrium phase diagram, but the U6Co and UCo phases exhibit certain compositional metastability.

2.1.2 Phase Composition of Ribbon Samples

[Figure 3: see original paper] shows the XRD patterns of rapidly quenched UxCo100-x (x=50~87.5) ribbons. Near the compositions of x=50 and 55, a near single-phase UCo structure formed, while in alloys with x=58.5 and 62.5, amorphous phase coexisted with U6Co and UCo phases, where the amorphous diffuse peak was located between 35°~45°. This indicates that the eutectic composition U62.5Co37.5 has relatively poor glass-forming ability. It should be pointed out that in ribbon alloys with x=50 and 55, the (220) crystal plane of the UCo phase shows the strongest diffraction, while in ribbons with x=58.5 and 62.5, only the (200) diffraction peak appears, showing obvious preferred orientation. In samples with compositions of x=65, 66.7, 69.2, 72, and 78, the amorphous phase is the main phase coexisting with a small amount of UCo phase. Based on the symmetry and smoothness of the main diffuse peak of the amorphous phase in the XRD patterns, it can be preliminarily judged that the ribbon alloys at compositions x=65, 66.7, and 69.2 have higher amorphous content and greater glass-forming ability. By calculating the peak areas of the UCo phase and amorphous phase, the UCo phase content in these three alloys can be semi-quantitatively determined as 9.5%, 4.8%, and 14.5%, respectively, further indicating that U66.7Co33.3 alloy has greater glass-forming ability. In ribbon alloys with compositions x=83.3, 85.7, and 87.5, there is basically no amorphous phase; instead, supersaturated solid solution phases isostructural with orthorhombic α-U formed, with lattice parameters: for x=83.3, a=0.2860 nm, b=0.5840 nm, c=0.5010 nm; for x=85.7, a=0.2858 nm, b=0.5860 nm, c=0.4960 nm; and for x=87.5, a=0.2856 nm, b=0.5832 nm, c=0.4961 nm. These lattice parameters are similar to those of pure α-U (a=0.2854 nm, b=0.5870 nm, c=0.4955 nm). Thus, rapid quenching at compositions x=83.3, 85.7, and 87.5 causes significant compositional metastability. For U85.7Co14.3 alloy, Drehman and Poon reported that it could form an amorphous phase and presented its XRD pattern (Mo Kα, λ=0.07093 nm), which showed three diffuse peaks with the first and second diffuse peaks located near 2 =17.5° and 27.5°, respectively, exhibiting relatively high diffraction intensities. Converting to Cu Kα radiation

(λ=0.15406 nm), the amorphous diffuse peaks are located around 2 =37° and 62° (the diffraction peak near 2 =28° is attributed to the UCo phase), which is close to the amorphous diffraction peak positions for alloys with x=65, 66.7, 69.2, 72, and 78 in this experiment ([Figure 3: see original paper]). Since the melt-spinning rate used in reference [18] was between 50~75 m/s, for further comparison, this work also prepared U85.7Co14.3 alloy ribbons at a melt-spinning rate of 75 m/s, but still failed to obtain an amorphous phase, instead mainly obtaining the α-U solid solution phase.

These experimental results indicate that under slow cooling solidification conditions, near-single-phase U6Co formed at compositions x=85.7 and 87.5, while compositionally metastable U6Co and UCo phases were obtained at other compositions. Under melt-spinning conditions at 50 m/s, significant compositional metastability occurred at high U content (x$ $83.3), forming supersaturated α-U phase; UCo phase formed at low U content (x$ $55); and amorphous phase could form in the composition range of 58.5–78, where the alloy with x=62.5 showed relatively poor glass-forming ability. The glass-forming ability of the U-Co binary system is asymmetric around the eutectic point, with greater glass-forming ability at high U content compositions near the right side of the eutectic point in the phase diagram, roughly in the composition range of x=66.7~69.2. The determined amorphous composition range in the U-Co binary system is similar to that reported by Giessen et al. (U60Co40~U80Co20) and also falls within the composition range of U40Co60~U90Co10 reported by Drehman and Poon. Meanwhile, Giessen et al. pointed out that in U-Co amorphous alloys, small amounts of U6Co and another major unknown phase coexist with the amorphous phase, whereas in this experiment, the coexisting phases were U6Co (in U58.5Co41.5 and U62.5Co37.5) and UCo phases, with the latter being dominant.

2.2 Thermal Stability

[Figure 4a: see original paper] shows the DSC curves of UxCo100-x (x=62.5~78) ribbons at a heating rate of 20 K/min. No obvious glass transition temperature (Tg) features were observed. The alloy with x=78 exhibited typical single-peak crystallization behavior, while the others showed double-peak crystallization. Table 2 lists the initial dynamic crystallization temperature parameters (Tx) for these alloys, which are located between 534~550 K. With increasing U content, the Tx value first increases and then decreases, reaching the highest value of 550 K at the composition x=66.7. Giessen et al. measured the thermal stability of amorphous samples between U60Co40~U80Co20 at a heating rate of 40 K/min and found that their crystallization process contained 2~3 crystallization peaks, with Tx in the range of 545~555 K. Drehman and Poon reported Tx values of 509~534 K for amorphous alloys between U42Co58~U90Co10 at a heating rate of 10 K/min. For the same sample, higher heating rates result in higher measured dynamic crystallization temperatures, and clearly the Tx data from literature and this experiment reflect this trend. On the other hand, the crystallization enthalpy (ΔHc) of these ribbon samples is in the range of 4.8~8.5 kJ/mol, while Drehman and Poon reported ΔHc values of 4~9 kJ/mol for amorphous alloys in the U42Co58~U90Co10 composition range, and Elliott et al. reported ΔHc of 4.2 kJ/mol for U85.7Fe14.3 amorphous alloy. At the same heating rate (20 K/min), the ΔHc values for Zr55Cu30Al10Ni5 and Ca65Mg15Zn20 bulk metallic glasses are 4.2 kJ/mol and 1.7 kJ/mol, respectively, while those for Zr41.2Ti13.8Cu12.5Ni10.0Be22.5 and Pd43Ni10Cu27P20 amorphous alloys are 0.34 kJ/mol and 0.3 kJ/mol, respectively. Clearly, the exothermic heat of these conventional amorphous alloys is significantly lower than that of U-Co amorphous alloys, indicating that U-Co amorphous alloys exhibit stronger thermal effects during crystallization.

From the melting curves shown in [Figure 4b: see original paper], three alloys (x=62.5, 72, and 78) display double-peak melting behavior, but the second melting peak is very weak. Alloys with x=65, 66.7, and 69.2 show near single-peak melting, which means that during heating and crystallization of the ribbons, the supercooled liquids of these three alloys that deviate from the equilibrium eutectic composition formed eutectic-like structures. On the other hand, it also reflects that when more UCo or U6Co crystalline phases exist in the amorphous ribbons, the melting behavior becomes more complex. Table 2 lists the melting temperature (Tm) and liquidus temperature (TL) parameters for these alloys. It can be seen that their Tm values are basically consistent, located near 1010 K, which is close to the corresponding eutectic temperature of 1007 K in the equilibrium phase diagram. The TL values of amorphous samples with x=65, 66.7, and 69.2 are close, in the range of 1026~1028 K, while TL for x=62.5 is 1057 K, and TL for x=78 is 1099 K, approaching the equilibrium melting temperature of U6Co (1099 K).

To evaluate the glass-forming ability of alloys, Turnbull suggested using the reduced glass temperature Trg=Tg/TL as a criterion. Since no Tg was observed in the DSC curves of U-Co amorphous alloys, this work adopted the reduced crystallization temperature Trx=Tx/TL as the evaluation parameter for glass-forming ability, following the treatment in references [15,18]. The Trx values in the composition range of x=62.5~78 range from 0.486~0.535, first increasing and then decreasing with increasing U content. The lowest value corresponds to the alloy with x=78, while the highest value corresponds to the alloy with x=66.7 (Table 2). Combined with XRD results, it can be preliminarily concluded that the alloy with x=66.7 in the U-Co system has the strongest glass-forming ability. In the report by Giessen et al., the Tx/Tm values for alloys between U60Co40~U80Co20 ranged between 0.54~0.55, with no obvious trend. In the report by Drehman and Poon, the Tx/TL values for alloys between U42Co58~U90Co10 ranged from 0.38~0.51, first increasing and then decreasing with increasing U content, with the highest value corresponding to U72Co28 alloy. There are obvious differences between the literature reports and the results of this experiment.

2.3 Corrosion Resistance

[Figure 5: see original paper] shows the potentiodynamic polarization curves of UxCo100-x (x=62.5~78) amorphous alloys and depleted uranium (DU) in a 50$×10^{-6}$ Cl^- solution. Except for the alloy with x=78, whose corrosion potential (Ecorr) is lower than -100 mV, the Ecorr values of the other alloys are all near -50 mV, significantly higher than that of DU and much higher than that of Al-coated uranium metal (Ecorr lower than -500 mV). This demonstrates that U-Co amorphous alloys have strong corrosion resistance. The three U-Co alloys with x=62.5, 65, and 69.2 have similar Ecorr and pitting potential (Epit) values, and all exhibit "pseudo-passivation" characteristics, indicating that a protective oxide film still forms on the alloy surface. Although the alloy with x=72 has a relatively high Ecorr, it shows pitting characteristics when the polarization potential is slightly higher than Ecorr. The Ecorr of the alloy with x=78 is significantly lower than other alloys, and the anodic polarization part only shows active dissolution characteristics. From the potentiodynamic polarization curves, among these U-Co amorphous alloys, those with x=62.5, 65, and 69.2 have relatively good corrosion resistance, followed by the alloy with x=72, while the alloy with x=78 shows the worst performance. Combined with the previous thermal stability data, there is a positive correlation between the corrosion resistance and glass-forming ability of the U-Co amorphous alloy series, which also means that the presence of crystalline phases affects the corrosion resistance of amorphous alloys.

The formation of U-Co amorphous alloys in this experiment can be discussed from three aspects: thermodynamic metastable equilibrium, crystallization kinetics, and impurity effects. First, the amorphous composition characteristics of the U-Co system deviate from the eutectic principle proposed by Cohen and Turnbull. Chen first summarized the amorphous composition characteristics in several typical binary systems including Pd-Si, Zr-Ni, Ca-Al, Zr-Cu, and Hf-Be, finding that compositions with high glass-forming ability in these systems all deviate from the eutectic points in the equilibrium phase diagrams. The Zr-Cu and Ca-Al systems are biased toward the high-melting-point phase side, Pd-Si and Zr-Ni systems are biased toward the low-melting-point phase side, while the Hf-Be system is in the middle. In the Zr-Cu system, experiments by Wang et al. confirmed that within the Cu51Zr14-Cu10Zr7 composition range, compositions with higher glass-forming ability are also biased toward the high-melting-point phase (Cu51Zr14) side. Based on Cahn's thermodynamic metastable equilibrium theory, Dubey and Ramachandrarao studied numerous eutectic phase diagrams and first theoretically predicted that glass-forming ability is asymmetric around the eutectic point. Later, Highmore and Greer proposed that near the eutectic composition in metastable phase diagrams corresponds to large glass-forming ability. Based on the suggestion of Highmore and Greer, and noting the single-peak melting characteristic of alloys near the U66.7Co33.3 composition, it is speculated that this alloy composition falls within the metastable eutectic region bounded by the dotted lines in [Figure 6: see original paper]. Obviously, the liquidus near the metastable eutectic point extends to lower temperatures, which can result in higher Trx values, consistent with the Trx data trend in Table 2.

Furthermore, considering the crystal structures of U6Co and UCo phases, the former has complex atomic occupancy with significant chemical and topological short-range order (atomic clusters) at different atomic positions, while the latter has significant chemical disorder in specific atomic occupancy and a relatively simple bcc crystal structure with lower packing density. Alloy thermodynamics studies have shown that in a given system, the formation enthalpy of intermetallic compounds usually displays negative extreme values. Therefore, in amorphous alloy research, researchers have suggested that stable atomic clusters exist in melts near intermetallic compound compositions. The presence of these atomic clusters will affect the viscous flow of supercooled liquids. From a purely kinetic viewpoint, amorphous solids can be treated as configurationally frozen liquids, where Tg corresponds to a shear viscosity of 10^{13} Pa•s. For alloys on the U-rich side of the eutectic point U62.5Co37.5 in the U-Co equilibrium phase diagram, their supercooled liquids may contain atomic clusters with local structures similar to the U6Co phase, which will increase the resistance to viscous flow compared to completely disordered supercooled liquids. Therefore, only by increasing temperature under higher thermal activation conditions can the viscosity of the supercooled liquid be reduced, meaning that Tg for U-Co alloys near the U-rich side of the U62.5Co37.5 composition will gradually increase. Meanwhile, the presence of such short-range order will also lower the liquidus temperature to some extent. In summary, the supercooled liquids of U-rich alloys near the right side of U62.5Co37.5 are relatively favorable for amorphous formation from both metastable thermodynamic and kinetic perspectives.

Rapid quenching experiments on U-Co alloy melts indicate that at high U content (x$ $83.3), the supersaturated α-U phase is the competing phase to amorphous phase, while at low U content (x$ $55), the UCo phase is the competing phase, and the phase composition at these compositions is basically single-phase. Since this is close to congruent crystallization, the compositional conditions for nucleation of such crystalline phases are very easily satisfied and difficult to control kinetically during rapid quenching. In the composition range of 62.5%~78% U, the competing phases for amorphous formation are UCo and U6Co phases. Since the compositions of these two phases deviate significantly from the nominal alloy composition, their nucleation and growth require long-range diffusion of constituent atoms. Therefore, the crystallization kinetics of alloys in this composition range are relatively difficult, thus favoring amorphous formation. Comparing the two competing phases UCo and U6Co, although the latter has more favorable compositional conditions for nucleation, its crystal structure is very complex, and atomic rearrangement kinetics during nucleation and growth are relatively slow. On the other hand, since the alloy composition is close to the U6Co side, dense atomic clusters related to this phase can easily form in the alloy, expelling more excess volume, which may in turn favor nucleation of the UCo phase with simpler structure and lower packing density. Qualitative analysis suggests that the UCo phase is relatively easy to nucleate and competes with the amorphous phase, which is consistent with the phase identification results of this experiment.

Furthermore, due to the presence of a large amount of U-C compound impurities in the U raw material, the effect of heterogeneous nucleation on amorphous formation must be considered. Because of this impurity, the UCo phase competing with the amorphous phase can easily nucleate, making the suppression of its crystal growth the key to improving the glass-forming ability of U-Co alloys. Therefore, it is necessary to increase the cooling rate of U-Co alloy melts as much as possible. In view of this, rapid quenching experiments were conducted on U-Co alloys with x=66.7 using Cu roller linear speeds higher than 80 m/s. However, the precipitation of the UCo phase still could not be suppressed experimentally, indicating that the element diffusion kinetics required for crystal growth in U-Co alloys are extremely rapid. Based on research results on element diffusion in amorphous alloys, it is speculated that this is likely related to the decoupled rapid diffusion behavior of small Co atoms in supercooled melts.

To improve glass-forming ability, multicomponent alloying was performed on the U-Co system. By adding appropriate components to destabilize the UCo phase and increase atomic diffusion difficulty, single-phase amorphous alloys were successfully prepared using low-purity U raw materials. Related research results will be reported in subsequent work.

3. Conclusions

(1) In the U-Co system, the phase composition of slowly cooled UxCo100-x (x=50~87.5) alloy ingots is basically consistent with the equilibrium phase diagram. (2) During rapid solidification, U-Co alloys obtained obvious compositional and structural metastability: UCo phase formed in the range of x$ 55; *amorphousphaseformedintherangeof*58.5 *x* $78. (3) The glass-forming ability of alloys on the U-rich side of the eutectic point U62.5Co37.5 is relatively large, with optimal glass-forming ability appearing near the U66.7Co33.3 composition. (4) The corrosion potential of U-Co amorphous alloys is about -50 mV, and their corrosion resistance is significantly better than that of depleted uranium, with a positive correlation between alloy corrosion resistance and glass-forming ability.

Acknowledgments

The authors thank Tang Xian’ e, Chen Xianglin, Wang Qinguo, Zhang Yanzhi from China Academy of Engineering Physics, and Professor Dong Chuang and Qiang Jianbing from Dalian University of Technology for their help with this work.

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Note: Figure translations are in progress. See original paper for figures.

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