Title: **Optimizing chemistry of Al-based ternary metallic glass for improved mechanical property**

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Abstract: Aluminum-based Al-Tm-Re (TM-transition metals, RE-rare earth elements) metallic glass with high Al contents could exhibit high strength in combination with good ductility, which makes them suitable for application as structural materials. Their mechanical properties can even be further improved by annealing it under glass transformation temperature. But they could become brittle if intermetallic compounds precipitate in the primary crystallization process. At a result, the glass forming ability of the Al-based amorphous alloys has been drawing much attention.

To design a metallic glass having outstanding glass-forming ability(GFA), many experimental approaches have been proposed based on trial and error tests, but there are no justified theories and scientific rules. From previously research, there are several methods to predict the best glass forming ability for metallic glass, such as GFA linear regression analysis. As we know, ΔTx represents the stability of glass, it means how far is the crystallization from glass transition. A larger value of ΔTx could represent the better stability of glass against crystallization. Therefor, ΔTx can be used as a GFA parameter for Al-Tm-Re metallic glass.

My study reports how to optimize the glass-forming ability of Al-Tm-Re ternary metallic glasses by using single-objective and multi-objective optimization algorithm. For the single-objective method, we maximize the width of the super-cooled liquid region $\Delta Tx = Tx - Tg$ (Tx is crystallization temperature, Tg is glass transformation temperature). For the multi-objective method, we maximize both ΔTx and crystallization temperature Tx.

The best single-object optimized result we get is $Al_{20}Ni_{10}Ce_{70}$($\Delta Tx = 49.6$). The best multi-object optimized result is $Al_{16.5}Ni_{8}Ce_{75.5}$($\Delta Tx = 55.17$). This two best candidates as well as other three candidates were synthesized by using single-roller melt-spinning method. Then, the annealing treatment was conducted to improve the mechanical property of such MGs samples. The hardness, phase transfer analysis of original and annealed Al-Tm-Re samples were studied. The glass forming ability of different sample was measured and calculated. All the samples were annealed at five different temperatures. After each treatment, characteristic methods, i.e., X-ray diffraction, micro hardness were conducted on the initial sample and five annealed samples. XRD results demonstrated the amorphous and crystal structures were generated in this treatment and the average hardness was increase with the annealing temperature. The relationship between annealing temperature and hardness was also discussed.