Comparison of two different processing routes for production of $Fe_{48-x}Mo_{14}Cr_{15}Y_2C_{15}B_6Si_x$ (x = 0 or 8 at.%) metallic glasses and effect of Si addition on their glass-forming ability

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The Si addition in "soft magnetic” Fe-based metallic glasses may significantly increase their corrosion resistance due to the formation of SiO_2 passive film [1], although above a threshold Si can significantly reduce their glass-forming ability. Apart from this element, several other elements are usually added to Fe-based metallic glasses in small amount, which makes their processing difficult. Any deviation from the nominal chemical composition may drastically change their glass-forming ability, which requires a special care during their processing. Considering this, the present work aims to investigate the effect of Si addition on the glass-forming of $Fe_{48-x}Mo_{14}Cr_{15}Y_2C_{15}B_6Si_x$ (x = 0 or 8 at.%) metallic glasses and compare two processing routes for the production of these alloys, i.e. powder metallurgy followed by arc melting and direct arc melting. Ingots were prepared by these two different processing routes and ribbons were prepared by melt spinning. Ingots and ribbons of the $Fe_{48-x}Mo_{14}Cr_{15}Y_2C_{15}B_6Si_x$ (x = 0 or 8 at.%) were characterized by X-ray diffraction (XRD), differential scanning calorimetry (DSC) and scanning electron microscopy (SEM). The results show that the powder metallurgy route was less efficient than direct arc melting, since a large deviation of the chemical composition was observed. This occurred because several steps are required during processing, which caused a large weight loss of around 10 %. The addition of 6 at.% of Si to the $Fe_{48}Mo_{14}Cr_{15}Y_2C_{15}B_6$ alloy decreases its glass-forming ability and increases its crystallization temperature. A composite structure was formed in the ribbons with the presence of the amorphous and $B_2Fe_{15}Si_3$, $C_6Cr_{15,58}Fe_{7,72}$ and $Fe_{23}B_6$ phases.

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