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Investigation of high speed deformed Ni/Cu layers using Auger electron spectroscopy

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Ni/Cu double-layer and multilayer with various parameters for high speed deformation have been investigated using Auger electron spectroscopy (AES) with depth profiling analysis. Each Ni and Cu thin film has been alternatively deposited on a 0.3 mm thick Ni substrate using the RF magnetron sputtering system with Multipolar Magnetic Plasma Confinement (MMPC) method. The total thickness of the double-layer was 90 nm and that of the multilayer was 160 nm. High speed compression was performed with bullet masses from 30.0 g to 57.4 g under various bullet speeds from 16.8 m/s to 48.5 m/s. The strain rate ranged from 6.7×10^4 s^{-1} to 8.4×10^5 s^{-1}.

The thickness of the high speed deformed Ni/Cu double-layer has been reduced to about 80 % from that of the pristine sample. The thickness of the Cu thin film is reduced about 15 % more than that of the Ni thin film, which may come from the malleability difference between Cu and Ni. In case of 8.4×10^5 s^{-1} strain rate, however, the Ni/Cu double-layer has almost disappeared. The interdiffusion at the Ni/Cu interface is enhanced after the high speed deformation. The degree of interdiffusion seems to be greater at lower strain rate. A formation of $Cu_{0.5}Ni_{0.5}$ and $Cu_{0.75}Ni_{0.25}$ thin film alloy has been observed at the high speed deformed multilayer sample. It demonstrates that the high speed compression may become one of a useful method for the preparation of thin film metal alloys. But, further study of such a mixing behavior after the impact compression is needed.