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Glass shell etching to control residual quenching stress in Co-rich amorphous ferromagnetic microwires

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Abstract The magnetic properties of amorphous glass coated microwires are determined mainly by the distribution of residual quenching stresses over the microwire cross section. In this paper a control of the residual quenching stresses in amorphous ferromagnetic microwires is achieved by changing the microwire glass shell thickness by etching. To this end, a special gel is synthesized for precision glass shell etching of series of Co-rich microwires. The use of the gel provides a possibility of uniform etching of the microwire glass coating at a rate of 0.2-3.2 μm/h depending on the amount of glass already removed, a surface roughness being about 40 to 100 nm. It is also possible to completely remove the glass shell of the microwire without damage its metallic nucleus. The small angle magnetization rotation method has been used to determine the change in the amplitude of the residual quenching stress with a gradual decrease of the glass shell thickness of microwires of composition $Co_{67}Fe_4Ni_2Mo_2B_{11}Si_{14}$ and $Co_{71}Fe_4Si_{10}B_{15}$. It is found that the amplitude of the residual quenching stress deceases by 40 - 50% in average after removing of the layer of 1 μm thickness from the glass coating.

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Keywords: Amorphous ferromagnetic microwire, Residual quenching stress, Glass shell etching, Sensor applications