STRESSED-SENSIBLE MAGNETIC PROPERTIES OF AMORPHOUS MICROWIRES

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INTRODUCTION

The study of amorphous and nanocrystalline microwires in a glass shell is of fundamental and practical interest. This type of material has a wide range of high-frequency and magnetic properties. Natural ferromagnetic resonance, bistable magnetization reversal, low coercive force, and other properties determine the microwire as a promising material for magnetic electronics.

The core of the microwires is in the field of elastic stresses arising in the manufacturing process due to quenching and the difference in the thermal expansion coefficients of glass and metal. The stresses in combination with magnetostriction determine the magnetoelastic anisotropy of microwires, which, in turn, makes a significant contribution to the formation of a complex composite magnetic structure of such objects. The correlation between the stress state and the magnetic hysteresis characteristics of microwires is an interesting object to study from the point of view of creating magnetoelastic stress sensors on their basis. In this work, we studied the hysteresis magnetic properties of microwires of $Fe_{73.8}Cu_1Nb_{2.1}B_{9.1}Si_{13}$ composition (MW3.2) when they were stretched in situ.

The aim of this work was to develop a method for studying the hysteresis characteristics of microwires when they are stretched in situ.

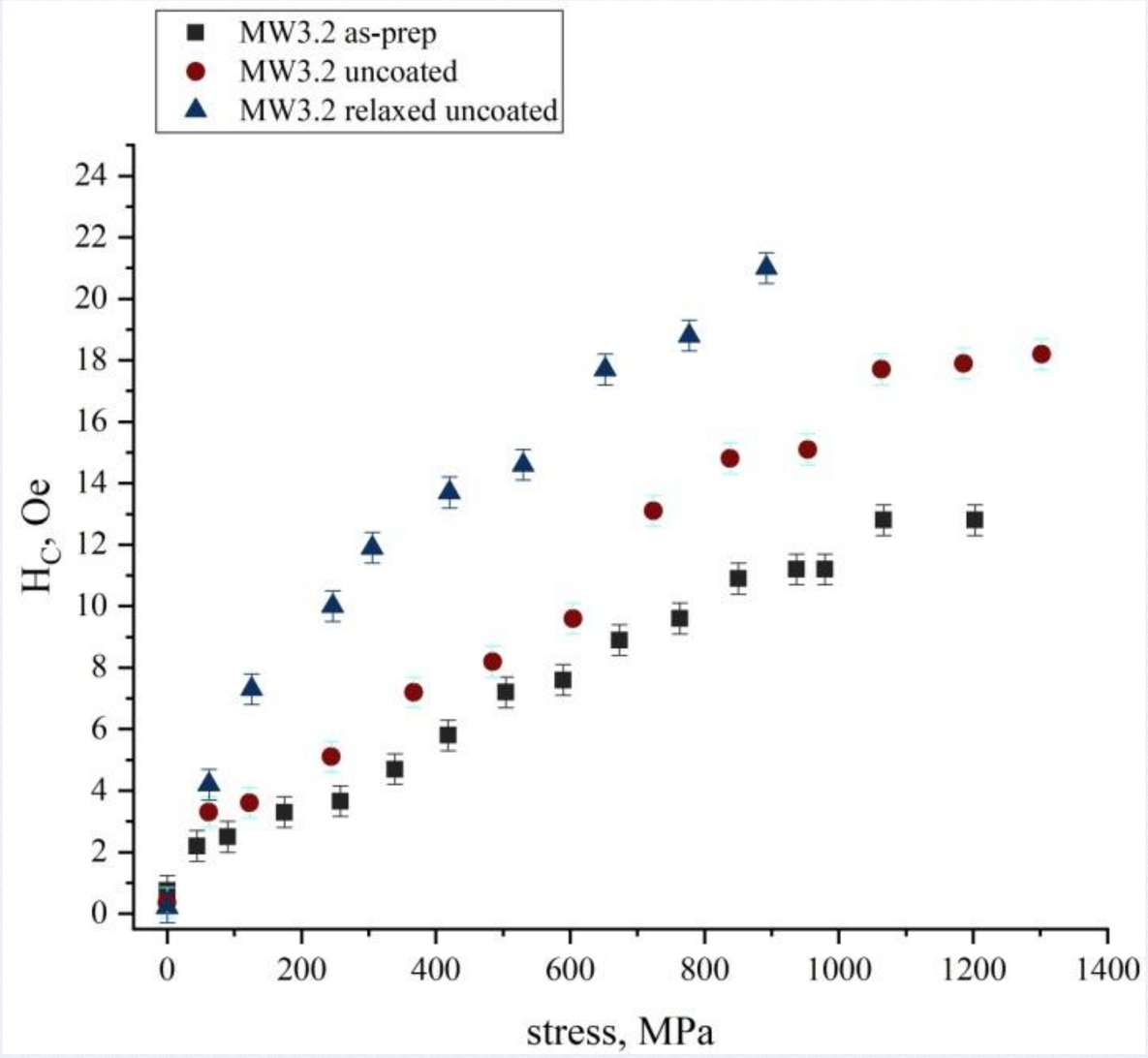


Fig. 3 – Coercivity versus stress tensile dependence for amorphous microwires

SAMPLES

Amorphous glass-coated microwires of $Fe_{73.8}Cu_1Nb_{2.1}B_{9.1}Si_{13}$ composition . The diameter of the metallic core is 16.5 μm, and the total diameter is 23 μm. Magnetostriction (λ_s) is $27x10^{-6}$.

METHODS

1. Magneto-optical method of indicator films.
2. Pick-up coil magnetometry
3. Vibrational magnetometry

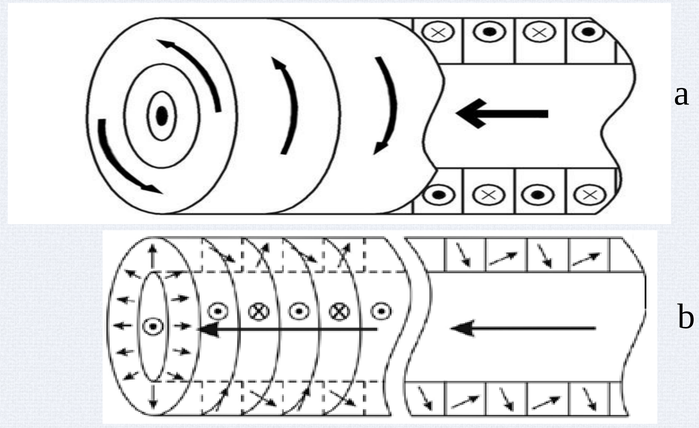


Fig. 1 – Magnetic structure of amorphous microwires: a) $\lambda_s<0$; b) $\lambda_s>0$;

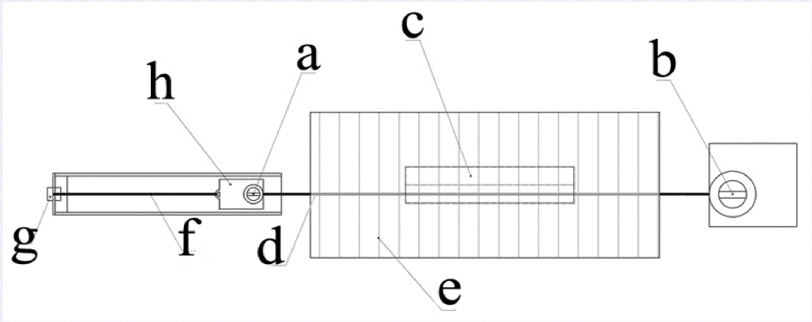


Fig. 2 – Diagram of the pick-up coil magnetometer: a-b – screw clamps for an amorphous wire, c – pickup coil, d – microwire, e – magnetizing coil, f – thread, g – load, h – movable carriage for fastening of a microwire.

RESULTS

In the framework of this work it was found:

1) the dependence of the coercivity H_C on the magnitude of the applied stresses σ has a linear form;
2) a decrease in the value of internal stresses leads to an increase in the proportionality coefficient of the H_C (σ) curve;
3) the obtained dependence is interesting from the point of view of the practical application of microwires as magnetic field stress sensors.
4) The research is carried out within the state task of ISSP RAS with the partial support of the RFBR (grants 18-32-00251).

RECENT PUBLICATIONS

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[4] Churyukanova M., Kaloshkin S., Shuvaeva E., Stepashkin A. et al. (2018) Journal of Alloys and Compounds 748:199.