Thermal stability of new hybrid Cu GO-Al_2O_3 metal matrix nanocomposites produced via High-Pressure Torsion

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Ultra-fine-grained and nanocrystalline materials have received scientific interest for many years due to their high mechanical strength. Poor thermal stability is one of the main obstacles to their wider practical application. Specifically, they recrystallize at relatively low temperatures and thus lose their enhanced strength properties.
In this work, materials were produced with a thermally stable nanocrystalline structure by adding small amounts of GO, Al_2O_3, and GO-Al_2O_3 nanoparticles to copper. This is the first research on the effect of the addition of hybrid GO-Al_2O_3 nanoparticles on the strength properties and thermal stability of copper matrix nanocomposites produced by high-pressure torsion (HPT).

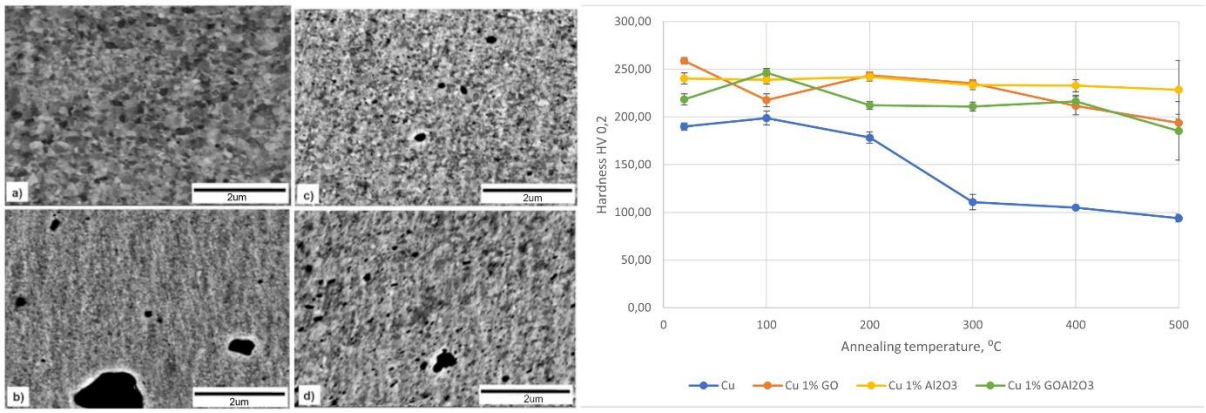

Figure 1. SEM images of a) copper after HPT, composites produced by HPT: b) Cu GO; c) Cu Al_2O_3; d) Cu GO-Al_2O_3; and e) hardness of composites in the function of annealing temperature

The produced composites have a nanocrystalline structure (fig. 1. b-d) with fairly equiaxial grains much smaller than copper after the same HPT treatment (fig. 1. a). The added particles are well distributed in the matrix, however, some larger agglomerates of particles are still visible. All composites have an increased hardness compared to copper after HPT.
Thermal stability studies have shown that the composite materials retain their increased hardness even at 500°C (fig. 1.e), whereas copper recrystallizes after HPT as early as at 300°C. It should be noted, however, that their microstructure after annealing varies depending on the type of particles added. The submitted poster will present a more detailed study of the microstructure and tensile properties of HPT-produced and subsequently annealed composites.