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Production and characterization of Al-Cu and Al-Ni nanoparticles

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Abstract: The present work deals with the production and characterization of metal and bimetallic nanopowders.

The electric explosion wire method for production of metal nanopowders is presented. The method enables to produce both metal and bimetallic nanoparticles (BMNP) with controlled content of metals within one particle. An alternative method to obtain bimetallic nanoparticles is also suggested using a spontaneous electrochemical process from salt solutions. BMNP for both Al-Cu and Al-Ni have been prepared and studied.

The oxidation, ignition and thermal reactivity of the BMNP of Al-Cu and Al-Ni in a simultaneous thermogravimetric (TG) and differential scanning calorimetry (DSC) experiments have been carried out. The microstructure has been characterized with a scanning electron microscope (SEM) and transmission electron microscope (TEM). The phase compositions of the reaction products have been investigated with X-ray diffraction.

By comparing the peak temperature of the first exothermic reaction in DSC and the phase transition temperatures in the respective binary systems, it has been found that for Al-Cu BMNP the melting of an alloy played a pivotal role for the early ignition reaction. The comparison of the reactivity of BMNP with that of aluminum nanoparticles has shown a greater reactivity of BMNP Al-Cu and Al-Ni.