INSITU SYNTHESIS OF IRON CARBIDE AND NICKEL NANO PARTICLES USING SPARK PLASMA SINTERING

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Abstract: Nanotechnology is one of the emerging fields of science, which has shown various paths of applications in medical, space and engineering. However, synthesizing and developing an economical and environmental procedure has always been a concern for sustainable development .There are two main approaches which are popularly known i.e. Top Down and Bottom Up approach. Here, Bottom Up approach is employed to synthesize the Nanoparticles. The iron carbide (Fe_3C) and nickel (Ni) nanoparticles (NPs) are synthesized *in-situ* using spark plasma sintering (SPS) technique. The initial reduction of Iron Nitrate and nickel acetate in carbon matrix is carried out at elevated temperature and pressure for a short duration during which the metal salts decompose resulting in the formation of NPs. It is found that appropriate pressure and temperature is required to form stable Fe_3C and Ni NPs. A set of experiments were carried out at various temperatures ranging between 600- 1000 ^oC, by keeping the pressure constant at 60 MPa. The SPSed products were characterized for crystal structure using X-ray diffraction, which revealed that the ferric nitrate converted to Fe_3C as shown in Figure 1(a), whereas the nickel acetate decomposed to form pure Ni as shown in figure 1(b). SEM images reveal that Fe_3C NPs are in the range of 60-70 nm and Ni NPs are in the range of 80-100 nm. Magnetic measurements were carried out using vibrating sample magnetometer (VSM), Fe_3C NPs possessed a saturation magnetization (M_s) of 126 emu/g and Ni NPs of 68 emu/g.

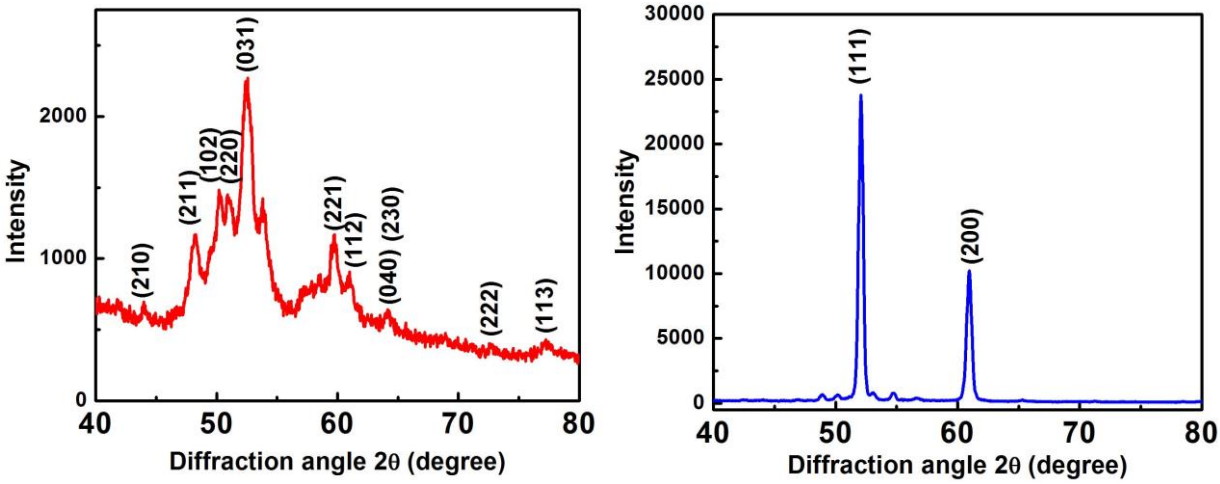

Figure1: (a) XRD pattern of iron carbide and (b) nickel nanoparticles obtained from in-situ decomposition of ferric nitrate and nickel acetate respectively in SPS.

***Keywords**: Nanoparticles, iron carbide, nickel, spark plasma sintering.*

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