Formation of Fe_3C Ultrafine Grains Covered with Carbon Layer

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To produce ultrafine grains covered with carbon of about 5 nm thick, an Fe wire of 5 mm length was inserted into a small carbon rod, as shown in Fig. 1 in the previous experiment on Si. The carbon hole was heated to 2968 K at a vapor pressure of 1 Torr. The TEM image and diffraction pattern of ultrafine fcc-Fe particles covered with an amorphous carbon layer are shown in Fig. 2. Ultrafine particles of less than 100 nm diameter are produced. The diffraction pattern confirms the fcc Fe particle and amorphous C growth. The surfaces of Fe particles are covered with the carbon layer. As indicated in Fig. 2(a), ultrafine fcc particles of less than 100 nm diameter were composed of 12 planes including {100} and {111} planes, as is the case for all metallic particles.

A typical image and diffraction pattern of Fe_3C are shown in Fig.3. The diffraction pattern indicates the formation of cementite (a=0.50896 nm, b=0.67433 nm, c=0.45248 nm) as reported on Metallurgy and Metallurgical Engineering series (353-365) and International Series of monographys on Metal physics and Physical Metallugge (919-923).. Since the heating temperature for forming particles shown in Fig. 2 is 950^{o}C by reported carbon atom in Fe particle of fcc structure. Since the (111) plane has the fcc packing structure, C atoms are introduced into Fe_3C, which contains 4 molecules in a unit cell. Therefore, the surface amorphous carbon layer is maintained.

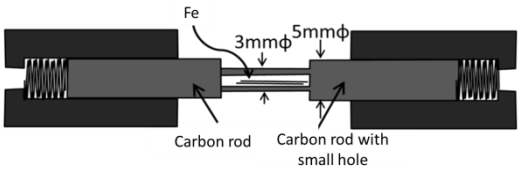

Fig. 1

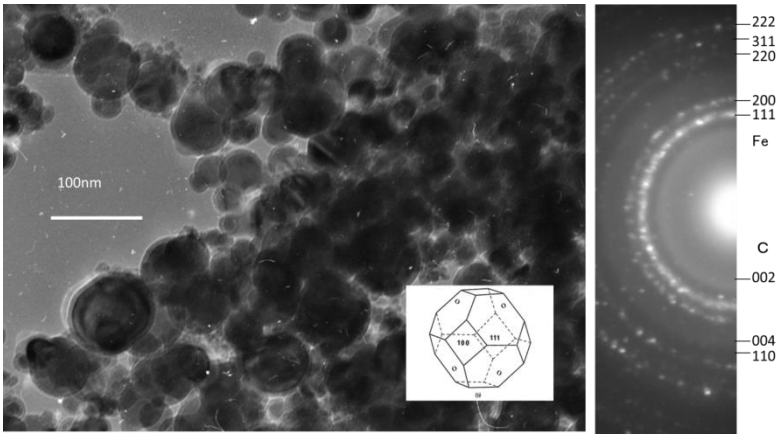

Fig. 2

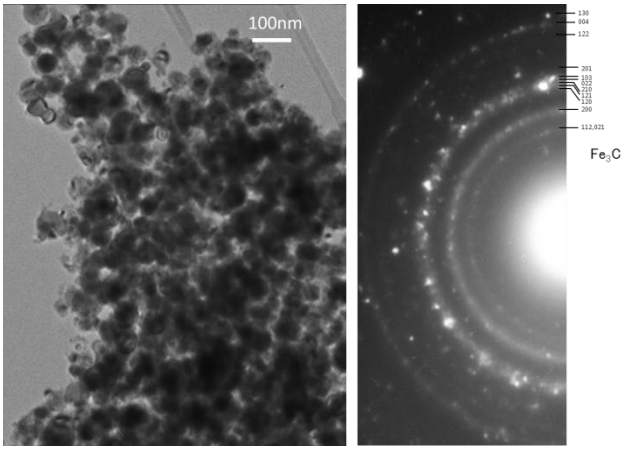

Fig .3