Structural transformation of carbon black using a metal catalyst

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Carbon exists in several allotropic forms, of which graphite, diamond and amorphous carbon are well known. Certain carbons can be transformed from one form to another and in this paper we discuss structural transformation of carbon black (CB).

CB is a well-known type of amorphous carbon which exists in the form of aggregated spheres. The possibility that CB might be available in a fullerene-like structure was first emphasized in 1986 [1]. Much work has been done on CB to transform it to nanotubes [2-4]. The transformation of CB into fullerenes or onion-like nanostructures has also been performed [5-6].

Many bent and faceted layer planes and few closed-shell structures could be obtained when CB was treated at high temperature [7]. Considering all the references above, it is clear that carbon which is in contact with metal catalysts at high temperature undergoes structural transformation.

CB used in this experiment was Cabot XC72R. The catalyst and organic solvent were ferrocene and ethanol, respectively. First, a small quantity of catalyst was dissolved in ethanol. Then, the solution was mixed with CB and the colloidal solution was subjected to ultrasonic vibration. Afterwards, the solution was transferred to a stainless steel cell and closed. The closed cell was placed inside the high-temperature furnace and kept at 700°C in N_2 atmosphere. After cooled down to room temperature, the dried carbon sample was treated with 8M HCl at 80°C for 1 hour and then kept at room temperature for 24 hours. Finally, it was filtered, washed with distilled water and dried at 110°C.

The sample was characterized using TEM (Transmission Electron Microscope) and the images are shown in Fig.1. From Fig.1, one can see that the carbon particles were transformed into hollow, round structures with diameter of approximately 50 nm.

Figure 2 shows the thermal behavior of carbon samples before and after structural transformation. It is evident from Fig.2 that structurally transformed carbon shows slightly less thermal stability compared to the parental CB.

BET measurement shows that the surface area was 286 m^2/g. This value is slightly greater than for Cabot XC72R (241 m^2/g).

In the next step, ethanol will be replaced by acetone as solvents and experiments will be repeated to study the solvent effect.

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Figures

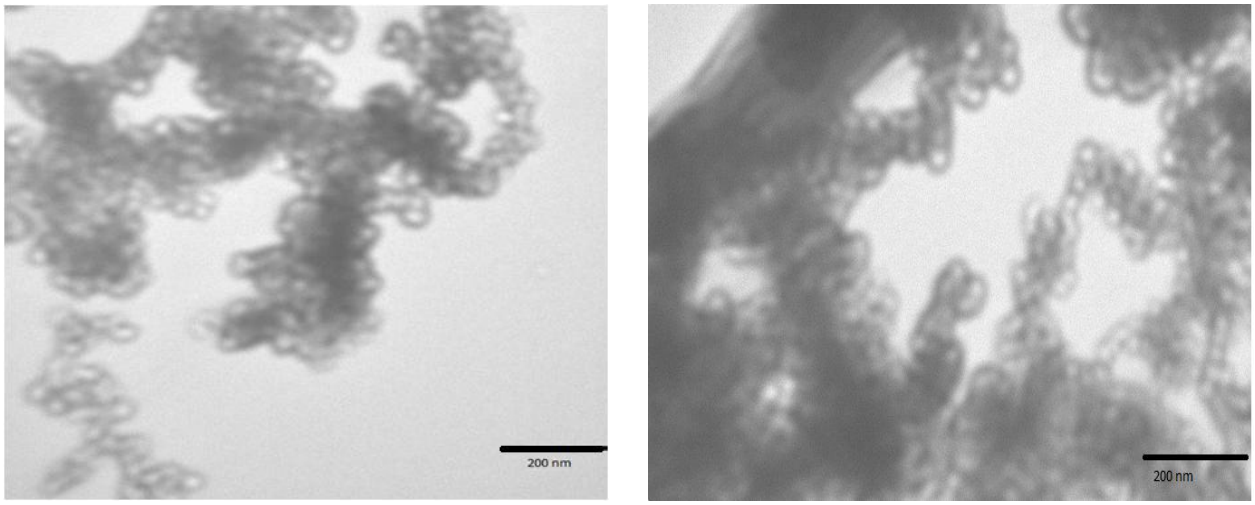

Fig. 1: TEM images of structurally transformed nanocarbon.

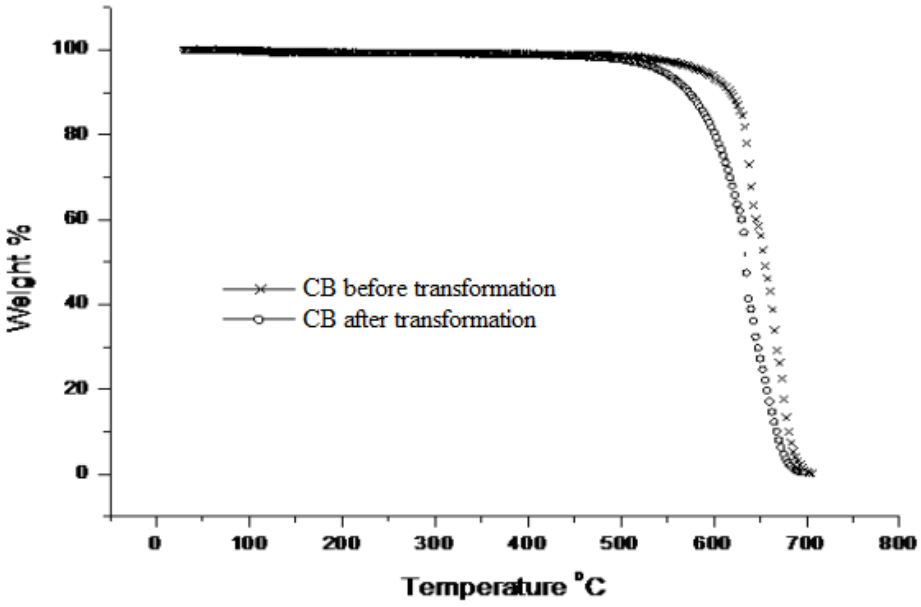

Fig. 2: TG graph of carbon sample before and after structural transformation.