DEPARTMENT OF APPLIED CHEMISTRY AND POLYMER TECHNOLOGY

DELHI COLLEGE OF ENGINEERING

BAWANA ROAD, DELHI-110042

CERTIFICATE

This is certified that the dissertation entitled "**Studies on Development of Copper–Carbon Composite"** submitted by **Mr. Devender Kumar** to Delhi College of Engineering (University of Delhi) in the Department of Applied Chemistry and Polymer Technology is a record of bonafide work carried out by him. Mr. Devender Kumar has worked under our guidance and supervision at **National Physical Laboratory**, New Delhi for fulfilling the requirement for the submission for this dissertation.

The result contained in this dissertation is original and has not been submitted to any University or Institute for the award of any degree.

Supervisor

Prof. G. L. Verma
Head, Department of Applied Chemistry
And Polymer Technology
Delhi College of Engineering
Delhi-110042

Co-supervisor

Dr. (Ms.) Saroj Kumari
Scientist 'B'
Physics and Engineering of Carbon
National Physical Laboratory
New Delhi-110012

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Devender Kumar
M.E. (Polymer Technology)
Roll No. 02/Poly/09
Delhi College of Engineering
Delhi-110042

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ABSTRACT

Copper-carbon composites with varying Cu/C ratio of 0.5 – 1.5 (by weight) were developed from coal-tar pitch derived green coke as carbon source and electrolytic grade copper powder at different heat treatment temperatures (HTT) of 1000-1400^{o} C. The physical, mechanical and electrical properties differ depending upon the HTT and also on Cu/C ratio. The composites prepared at HTT of 1000^{o} C having Cu/C ratio of 0.5 and 1.0 exhibited a high bending strength of 115 and 92 MPa, bulk density of 2.75 and 3.10 g/cc, electrical resistivity of 1.53 and 1.20 mΩcm and shore hardness of 98 and 92 respectively, in spite of well-known inadequate wettability between copper and carbon. Increasing the temperature from 1000^{o} C for processing of composites deterioted the properties mainly due to the loss of copper through melting above 1100^{o} C as revealed by X-Ray, scanning electron microscope and thermal analysis.

Nanoparticles of copper were coated on this fine (green Coke) GC powder by electroless method and heat treated in hydrogen atmosphere to reduce the copper oxide formed during electroless coating. The resulting copper coated GC moulded into plates and carbonized to 1000^{o} C to obtain Cu-C composite. The composites with Cu/C ratio of 0.50 exhibited higher bending strength of 156 MPa, bulk density of 2.90 g/cc and electrical resistivity of 0.42 mΩcm. On the other hand composites with Cu/C ratio of 1.28 showed bending strength of 110 MPa, bulk density of 3.37 g/cc and electrical resistivity of 0.14 mΩcm. The electroless copper coated GC powder/ composites were characterized

by XRD. Morphology and size of copper powder obtained by electroless method composites developed there from were also studied by SEM and TEM.

The copper-carbon composites developed from nano copper coated green coke powder exhibited much better mechanical and electrical properties as compared to those made from powder method.