PHYSICAL PROPERTIES OF CARBON NANOSTRUCTURES DERIVED FROM FULLERENE C_{70} AT HIGH PRESSURE

<u>A.V. Soldatov¹</u>, P. Nagel², S. Lebedkin³, D. Johnels⁴ and C. Meingast²

¹Department of Applied Physics and Mechanical Engineering, Lulea University of Technology, SE-971 87, Luleå Sweden

Forschungszentrum Karlsruhe – Technik und Umwelt, Institut für Festkörperphysik (²) und Institut für Nanotechnologie (³), PO Box 3640, D-76021 Karlsruhe, Germany ⁴Umeå University, Department of Chemistry/Organic Chemistry, SE-901 87 Umeå,

Sweden

It has been well established that application of high pressure to C_{60} at elevated temperatures results in formation of one-dimensional (1D) and two-dimensional (2D) polymeric structures comprised of covalently bonded buckyballs [1]. Nevertheless, numerous attempts to polymerize the next simplest fullerene, C_{70} , have generally been inconclusive and yielded only dimers (C_{140}) [2,3] until the polymer was finally synthesized at hydrostatic pressure in the form of zig-zag chains [4]. Here we present the results of a wide range of experimental studies (Raman, FTIR and NMR spectroscopy, thermal conductivity, high resolution dilatometry) of C_{140} and 1D polymeric C_{70} . We show that the type of nanostructure (dimers vs. chains) formed during polymerization of C_{70} at high pressure strongly depends on the structural state of the source material. In a separate set of experiments dedicated to study of the kinetics of de-polymerization of C_{140} and 1D polymeric C_{70} , we revealed a tremendous difference in the relaxation times for the process in these systems which we tentatively associate with the difference in entropy change during de-polymerization.

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