Further Studies on the Intrusion alloy of Copper particles with Dispersed Single-digit Nanodiamond Particles

K. Hanada*, K. Yamamoto[#], E. Osawa[§], M. Inakuma[§], V. Livramento[¤], J.B. Correia[¤], N. Shohoji[#]

**National Institute of Advanced Industrial Science and Technology, 1-2-1 Namiki, Tsukuba, Ibaraki 305-8564, Japan*

[#]Japan Atomic Energy, Quantum Beam Science Directorate, 2-4 Shirakata, Tokai-mura, Naka-gun, Ibaraki, 319-1195, Japan

[§] NanoCarbon Research Institute 301 Toudai Kashiwa Venture Plaza, 5-4-19 Kashiwa-no-Ha, Kashiwa, Chiba 277-0882, Japan

[¤]Instituto Nacional de Engenharia, Tecnologia e Inovacao, Estrada do Paco do Lumiar, 22, 1649-038 Lisboa, Portugal

Successful dispersion of the long-sought primary particles of detonation nanodiamond single crystals having an average diameter of 4.3±0.3 nm opened up a wide horizon } for studying this immensely interesting material. Advantages are too numerous to cite, but the most recent news on the outstanding propert ies of nanodiamond is the total absence of any measurable toxicity to neuroblastoma cell and even serves as a substrate of growth for the cell (Dai, 2006).

One of the potential areas of application that might influence a large sector of industry would be composites dispersed with nanodiamond particles as the re-inforcing component. We began systematic screening of nanodiamond containing alloys (NDCA) and this lecture reports the preliminary results. The first experiments have been carried out using copper as the matrix element in view of its slow reaction with atmospheric oxygen and also relative high inertness towards carbide formation. Remarkable increase in the microhardness of powder products from mechanical alloying of micron-sized copper particles and loose aggregates of nanodiamond have been reported [V. Libramento *et al* . *Diam. & Rel. Mater.* submitted for publication]. Consolidation was carried out by two methods, extrusion moulding and spark plasma sintering (SPS), both at 600°C in order to avoid diamond-graphite phase transition. Results of TEM examination on the FIB film of the consolidated samples and of compression testing will be report in detail.

One critical problem is already apparent at the time of writing this abstract: incomplete disintegration of nanodiamond aggregates. The diamond particles have sharp distribution of size with an average coherent scattering region at 4.3±0.3 nm, but had been aggregated to micron sizes upon drying. Ball milling with 10 mm SUS balls disintegrated the loose aggregates only to 20-50 nm during the mechanical alloying process according to the TEM observation of the consolidated product. Measures to achieve higher dispersion will be tested and discussed.