



## NECEM Seminar: NANODIAMOND: A NEW ENERGY MATERIAL

Prof Eiji Ōsawa, Professor Emeritus/NanoCarbon Research Institute,  
Ueda, Japan

13:00pm-14:00pm, 4th December 2018

Newcastle University, Bedson Building, First Floor, Lecture Theatre,  
Room BEDB 1.75

Refreshments available from 12:30pm-13:00pm

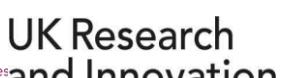
All welcome

### NANODIAMOND: A NEW ENERGY MATERIAL

#### Abstract:

One of the longest pending problems in science, identification of detonation nanodiamond (DND) discovered in 1963, is finally solved. The notorious tight aggregation in DND could be destroyed by attrition milling assisted by Wigner-Seitz theory of interparticle distance, Taguchi's method of quality engineering and an interpretation of LDI-TOF-MS. The primary particles of DND, with diameter of  $2.6 \pm 0.5$  nm, proved to have graphene oxide patches on the surface, extensively disordered diamond phase near the surface, and a cube-shaped diamond single crystal consisting of exactly 1000 carbon atoms. Total number of carbon atoms in a DND is predicted to be 1670 by both SCC-DFTB calculations and by mass analysis. DND is by no means a simple nano-version of large diamond crystals, but a novel hybrid nano-carbon consisting of  $sp^2$ ,  $sp^{2+x}$  ( $0 < x < 1$ ) and  $sp^3$  carbon atoms.

We are currently exploring its applications taking advantage of high sphericity, hardness and chemical stability in DND. In this lecture two of the most promising experiments will be mentioned: (1) toughening of solid materials by dispersing DND, (2) and generation of zero-friction lubrication liquid (DND dissolves well in water and a few organic solvents like ethylene glycol EG). Taking advantage of these remarkable results we will briefly talk about a realistic plan to reduce emission of green-house gases by stopping the abuse of steel for transportation equipment like cars and airplanes. This goal may be reached by replacing steel with, for an example, DND-dispersed plastics like PET. Moving machines made from



the tough plastics may be lubricated by, for an example with dilute DND solution in EG, wherein DND particles work as rolling nano-spacers to produce virtually frictionless systems. Steel machines and lubrication oils are the last giant 'necessity evils' still wandering in our modern society.

### **Professor Eiji Osawa Biography**



Prof Eiji Osawa is a former Professor of computational chemistry from Kyoto University, he theoretically predicted the C60 molecule in 1970 and published in a Japanese journal. The first experimental evidence of C60 (fullerene molecule) was discovered in 1985, 15 years later, by Prof. Richard Smalley (USA), Sir Harold Kroto (UK) and Prof. Robert Curl (USA), they obtained the Nobel prize in Chemistry in 1996 for fullerene discovery. Fullerene family discovery is taken as the beginning of the field of modern Nanoscale Science and Nanotechnology.

#### **Work:**

Developments of nanocarbons at NanoCarbon Research Institute Limited, Asama Research Extension Centre, Faculty of Textile Science and Technology, Shinshu University, 3-5-1 Tokita, Ueda, Nagano 386-8567, Japan, Tel 81-(0)268-75-8381 Fax 81-(0)268-75-8551 URL: <http://nano-carbon.jp>

#### **Education:**

1958 B. Eng. Department of Industrial Chemistry, Kyoto University, Kyoto, Japan.

1960 M. Eng. Graduate School of Engineering, Kyoto University, Kyoto, Japan.

1966 Dr. Eng by Thesis. Kyoto University, Kyoto, Japan.

2001-present President, NanoCarbon Research Institute Limited, Ueda, Nagano

#### **Interests:**

(i) Present: Science and technology of nanocarbons including C60 and other fullerenes, nano-onions, McKay crystals and detonation nanodiamonds

(ii) Past: Hydrocarbon chemistry, computational chemistry

(iii) Latest interests: Dispersed nanodiamonds (av diameter  $2.6\pm0.5$  nm) and their applications

#### **Honours, Awards, Fellowships, and Nominations:**

- Chunichi Culture Prize, Nagoya, Japan, 2001.
- Emeritus Professorship, Toyohashi University of Technology, Toyohashi, Japan, 2001
- Emeritus Professorship, Xi'an Communication University, Sian, China, 2004

- Honorary foreign member of the Ioffe Physico-Technical Research Institute, St. Petersburg, 2007.

**Publications:**

- 357 Original research papers in refereed journals
- 76 Books, book-chapters and editorships
- 166 Proceedings of international conferences and major reports,
- 30 Patents and patent applications
- 215 Articles in commercial and popular journals, h-index 55. (as of Jan. 2018)

**Accomplishments:**

- One of the organizers of MRS Symposium, “Nanodiamond Particles and Related Materials-From Basic Science to Applications,” San Francisco, Spring, 2012, 2014 and Phoenix, Spring, 2016.
- Established The Fullerenes and Nanotubes Research Society in 1992, served as Acting President until 2001 and started General Fullerene and Nanotubes Symposia which celebrated its 40th Meeting in 2010 and still is continuing. The Society is now a registered Fullerenes, Nanotubes and Graphene Research Society with about 800 active membership.
- Since 2003, Ōsawa Prize is yearly presented in The FNTRS to the winners of competition among young scientists for outstanding achievements in research on fullerene science.
- Appeared in a few textbooks of high-school chemistry in Japan for the prediction of C60.
- Appeared in Wikipedia under Fullerene for the prediction of C60.

Seminar Venue: Newcastle University, Bedson building, first floor, Lecture Theatre, room BEDB 1.75

