Self-similar patterning of inversion domains in Al-Cu-Co decagonal quasicrystals

Eiji Abe, Shunsuke Taniguchi
University of Tokyo, Department of Materials Engineering, 7-3-1, Hongo, Bunkyo-ku, Tokyo, 113-8656, Japan, E-mail: abe@material.u-tokyo.ac.jp

We find a striking distribution of inversion domains in a decagonal Al$_{64}$Cu$_{22}$Co$_{14}$, which reveals a fractal-like, self-similar microstructure constructed by golden triangles (similar to a Sierpinski Gasket). This unique morphology of domains is confirmed to be thermodynamically stable configurations at high temperatures (>\sim 1200K), just below the melting temperature of the Al$_{64}$Cu$_{22}$Co$_{14}$ compound. Details of the domain microstructure are described based on dark-field TEM imaging, convergent electron diffraction and atomic-resolution STEM. We propose that the occurrence of such self-similar domains may well be understood by concerning structural modulations extended into a hyperspace.

Keywords: quasicrystals, electron diffraction, electron microscopy

Thermal stability study and structural of palladium platinum nanoparticles by HREM

Nancy Castillo$^{1,4}$, Lucia Diaz Barriga$^2$, Ramiro Perez$^3$, Agustin Condé$^4$
$^1$Universidad Nacional Autonoma de Mexico, Facultad de Quimica, Metalurgia Y Materiales, Cd. Universitaria, Ed. B, Facultad de Quimica, Unam, C.P., Mexico D.F., Mexico, 04510, Mexico, $^2$Instituto Politecnico Nacional ESIQIE, Mexico D.F., 07305, Mexico., $^3$Instituto de Ciencias Fisicas, Cuernavaca Mor., 07305, Mexico, $^4$Centro de Investigacion y de Estudios Avanzados del IPN, Fisica, Mexico D.F., 07360, Mexico., E-mail: necastillo@yahoo.com

Platinum (Pt) Palladium (Pd) nanoparticles supported on amorphous silica (SiO$_2$) were prepared by wetness impregnation techniques at same concentrations of Pt(0.5) and Pd(0.5); 1 metallic wt %. The particle size distribution were measured as function of reaction temperature, temperatures were varied in the range of 200°C - 400°C to evaluate the nucleation phenomena and thermal stability. In addition morphology and crystallinity under various reactor temperatures were investigated by physiosorption Brunauer-Emmett-Teller-(BET), X-Ray Diffraction (XRD), High Resolution Electron Microscopy (HREM) and Transmission Electron Microscopy (TEM). In this work, we observed the distribution of Pt and Pd in nanoparticles. The rational design of nanoscale structures for applications in technology increasingly relies on developing and improved understanding of processes, particularly in terms of how they contribute to the changing phase behavior of nanoscale systems. Crystal structures can be determined by X-ray, while transmission electron microscopy (TEM) is indispensable for characterization of nanocrystalline materials, because TEM is a tool that provides not only atomic resolution lattice images but also chemical information at a spatial resolution, allowing direct identification the chemistry of a single nanoparticle.

Keywords: nanoparticles, metals, HREM

Morphological studies on single crystals and nanofibers of poly(heptamethylene terephthalate)

Yutaka Kawahara$^1$, Satoshi Nakuro$^2$, Atsushi Nakayama$^1$, Ming-Chien Wu$^3$, Eamor M. Woo$^3$, Masaki Tsuji$^4$
$^1$Gunma University, Japan, $^2$Graduate School of Science and Technology, Kyoto Institute of Technology, Kyoto, 606-8585, Japan, $^3$Department of Chemical Engineering, National Cheng Kung University, Tainan, 701-01, Taiwan, $^4$Institute for Chemical Research, Kyoto University, Uji, Kyoto, 611-0011, Japan, E-mail: kawahara@ns.bcc.gunma-u.ac.jp

Poly(heptamethylene terephthalate) (PHePT), which is one of aromatic polyesters, was synthesized, and its lamellar single-crystals were grown isothermally, for example at 70°C, from a dilute solution in 1-octanol. Nanofibers of PHePT were prepared via electro-spinning (apparatus: esprayer ES-1000 (Fuence Co., Ltd.; Tokyo, Japan)) of a solution in 1,1,3,3,3-hexafluoro-2-propanol. Morphology of the single crystals and that of as-spun and annealed nanofibers were investigated with a transmission electron microscope (JEOL JEM-200CS) which was operated at 200Kv. Selected-area electron diffraction (SAED) of the crystals gives a well-defined N-pattern consisting of spot-like 680 reflections, and that of a bundle of the annealed nanofibers gives a highly oriented fiber pattern. From the analysis of SAED patterns for both types of specimen, namely single crystals and nanofibers, it seems that PHePT takes an orthorhombic crystal system and its unit cell parameters are as follows: $a = 1.409\text{nm}$, $b = 1.480\text{nm}$, $c$ (chain axis) = 3.392nm, $\alpha = \beta = \gamma = 90^\circ$. In addition, dark-field images of the PHePT nanofibers which had been annealed at 85°C for 2 days were taken by using some of the reflections on near the equator. The images showed a stacked-lamellar structure, in which crystalline lamellae are stacked in the direction of the fiber axis, and the corresponding average long period was estimated at about 19nm.

Keywords: polymer single crystal, nanofiber, poly(heptamethylene terephthalate)