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Masahiro Yoshimura
National Cheng Kung University, Taiwan

Importance of soft processing (low-energy production) of advanced inorganic materials for sustainable society

Like organic and/or bio-materials, advanced inorganic materials, most of metallurgical materials, semiconductors and ceramic materials are important, but they have never been produced in natural biological systems. Thus they have generally been fabricated artificially and/or industrially by so-called high technology, where high temperature, high pressure, vacuum, molecule, atom, ion, plasma, etc. giving environmental impacts, particularly for nanostructured advanced inorganic (ceramics) materials. Considering the lowering of total energy consumption, we have challenged to fabricate those advanced inorganic materials with desired shape/size/location, etc., directly in low energetic routes using aqueous solutions. Since 1989, when we found a method to fabricate $BaTiO_3$ film on Ti substrate in a $Ba(OH)_2$ solution by hydrothermal electrochemical (HEC) method at low temperatures of 60-200°C. We proposed in 1995 an innovative concept and technology, "soft processing" or "soft solution processing," which aims at low energetic (environmentally friendly) fabrication of shaped, sized, located, and oriented inorganic materials in/from solutions. When we have activated/stimulated interfacial reactions locally and/or moved the reaction point dynamically, we got patterned ceramic films directly in solution without any firing, printing, masking nor etching. We have succeeded in direct patterning of CdS, PbS and $CaWO_4$ on papers by inkjet reaction method; furthermore, to fabricate $BaTiO_3$ patterns on Ti by a laser beam scanning and carbon patterns on Si by a needle electrode scanning directly in solutions. TiO_2 and CeO_2 patterns by inkjet deposition, where nano-particles will nucleate and grow successively on the surface of substrate thus making dense even below 300°C will be presented. 2D and 3D nano-structured films will be also discussed. A recent novel subject, soft processing for various nano-carbons including graphene and functionalized graphene, will be introduced.

Biography

Masahiro Yoshimura is the Chair Professor of Materials Science and Engineering at Promotion Center for Global Materials Research (PCGMR) and National Cheng Kung University (NCKU), Taiwan. He has earned his DSc in Tokyo Institute of Technology, Japan. He was a Post-doctoral Researcher in CNRS Lab in Orleans. In 1978, he became an Associate Professor at Tokyo Institute of Technology, Japan. He has worked on phase equilibria of zirconia, rare earth oxides and hydrothermal solution processes of zirconia, HAp, $BaTiO_3$, $LiCoO_2$ and nano-carbons. He has more than 700 peer-reviewed papers and 16,500 citations.

yoshimur@mail.ncku.edu.tw