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Title: Design, preparation and characterization of functional Nanomaterials based on energy-resolved distribution of electron traps

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How can we design functional solid materials, such as catalysts and photocatalysts? What is the decisive structural parameters controlling their activities, performance or properties? What is obtained as structural properties by popular conventional analytical methods, such as X-ray diffraction (XRD) or nitrogen-adsorption measurement, is limited to bulk crystalline structure and specific surface area, i.e., no structural characterization on amorphous phases, if present, and surface structure has been made so far. This is because there have been no macroscopic analytical methods to give surface structural information including possibly-present amorphous phases. Recently, we have developed reversed double-beam photoacoustic spectroscopy (RDB-PAS) which enables measure energy-resolved distribution of electron traps (ERDT) for semiconducting materials such as metal oxides [1,2]. Those detected electron traps (ETs) seem to be predominantly located on the surface for almost all the metal oxide particles, and therefore they reflect macroscopic surface structure, including amorphous phases, in ERDT patterns. Using an ERDT pattern with the data of CB bottom position (CBB), i.e., ERDT/CBB pattern, it has been shown that metal oxide powders, and the other semiconducting materials such as carbon nitride, can be identified without using the other analytical data such as XRD patterns or specific surface area, and similarity/differentness of a pair of metal-oxide samples is quantitatively evaluated as degree of coincidence of ERDT/CBB patterns. An approach of material design based on the ERDT/CBB analyses is introduced [3].

[1] Chem. Commun. 2016, 52, 12096-12099. [2] Electrochim. Acta 2018, 264, 83-90. [3] Catal. Today 2019, 321-322, 2-8.

Biography

The research work on photocatalysis by Professor Ohtani started in 1981 when he was a Ph. D. course student in Kyoto University. Since then he has been studying photocatalysis and related topics for more than 30 years and published more than 300 original papers (h-index: 72) and two single-author books. After gaining his Ph. D. degree from Kyoto University in 1985, he became an assistant professor in the university. In 1996, he was promoted to an associate professor in Graduate School of Science, Hokkaido University and was then awarded a full professor position in Institute for Catalysis, Hokkaido University in 1998 before the retirement at March 31, 2022.