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Growth of Photocatalytic Crystals from a NaCl Flux and Their Application

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Summary

The fabrication of one-dimensional (1D; e.g. tubes, fibers, rods and whiskers), two-dimensional (e.g., sheets and plates) and three-dimensional (e.g., bulks and porous structures) materials appropriate for a wide variety of leading edge technologies has recently been of great interest. In particular, 1D nanomaterials exhibit the unique physical and chemical properties correlated with the 1D structural confinements in the nanoscale. Our research motivation is to produce highly efficient materials for use as photocatalysts for degradation of toxic substances and for decomposition of pure water, or photoactive electrodes in dye-sensitized solar cells (DSSCs). We recently reported on the growth of smart whiskers from a NaCl flux (H19) and the growth of smart crystals from a NaCl flux and their application (H20). Herein, we report on the fabrication of photocatalytic crystals from a NaCl flux and their application for environmental functional materials.

First, a variety of nanometer-sized crystals (particles, tubes and sheets) were successfully fabricated by the chemical treatment (exfoliation and roll-up). $K_4Nb_6O_{17}$ and $Na_2Ti_3O_7$ crystals were selected as the target compounds because their crystallinity, structures and sizes were easily controlled by flux growth conditions. Next, the photocatalytic propertiy of Nb_2O_5 nanotubes synthesized from the flux-grown $K_4Nb_6O_{17}$ crystals was studied by an organic gas degradation under ultraviolet light irradiation. The photodegradation occurred mainly via the photocatalytic process and the photocatalytic activity of the nanotubes was much higher than that of the flux-grown $K_4Nb_6O_{17}$ crystals. The surface area of the nanotubes, which is very important for photocatalytic property, was greatly increased by their morphology transformation. Finally, the Nb_2O_5 nanotubes were successfully employed as a photoactive electrode material in DSSCs.