Synthesis of Si-based Nanosheet Bundles using Metal Chlorides in Solutions

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Introduction: A nanosheet bundle is one of the important structures for technological applications, such as thermoelectricity, and use in solar cells and Li-ion batteries. In this paper, the nanosheet bundle is defined as an aggregate of long nanosheets that are highly oriented, well-aligned, dense and tied together in higher densities. It has been demonstrated that Si-based nanosheet bundles can be prepared. The synthesis of Si nanosheet bundles by extraction of the Ca atoms from $CaSi_2$ crystals using Inositol hexakisphosphate (IP6) has been reported [1]. The structural property of the resultant Si-based nanosheet bundles depends on reactant agents with $CaSi_2$ and solutions, and it is affected by the exfoliation mechanism of the Ca atoms from the $CaSi_2$ crystals. In this paper, synthesis of Si-based nanosheet bundles from $CaSi_2$ using selected chloride compounds is reported.

Experiments: Commercially-available $CaSi_2$ crystal powders were used as the source material. The Si-based nanosheet bundles were formed by Ca-atom extraction from the $CaSi_2$ crystals by chemical reactions with $CuCl_2$, $TiCl_3$, $RuCl_3$, H_2PtCl_6 and their related compounds in aqueous, dilute HCl acid and propylene carbonate (PC) solutions. The structural properties of these nanostructure bundles were characterized and compared to each other.

Results and Discussion: Figure 1 shows TEM images of Si-based nanosheets bundles synthesized with $TiCl_3$, $RuCl_3$ and H_2PtCl_6 in aqueous solution and $CuCl_2$ in PC solution. For the case of $TiCl_3$, the formation of the bundle structures is observed by the exfoliation of the sheets each other. In addition, stripped pattern along the sheet surface is also observed.

For $RuCl_3$, and H_2PtCl_6, metallic precipitation is additionally observed. Metallic precipitation with large size distribution is also observed for $CuCl_2$ in PC solution. The atomic scale structural modifications from $CaSi_2$ crystals will be also presented.

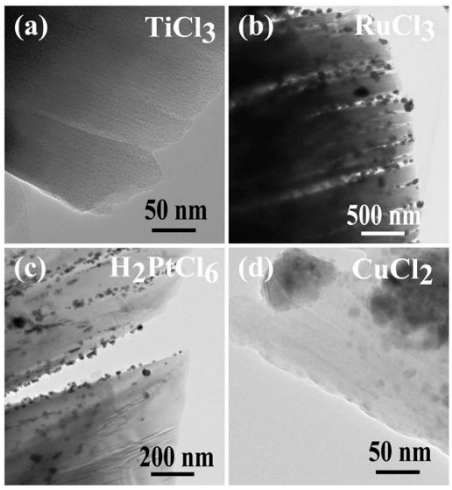

Fig. 1 TEM images of the nanosheet bundles synthesized by the chemical reactions.

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References

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