Graphene/FeSn\textsubscript{5} nanocomposite with stable and high capacity as anodes for Li-ion batteries

Feng-Xia Xin, Xiaoliang Wang\textsuperscript{1}, Huajun Tian, Wei-Qiang Han*  
Ningbo Institute of Materials Technology & Engineering (NIMTE), Chinese Academy of Sciences, Ningbo, 315201, P. R. China. e-mail: hanweiqiang@nimte.ac.cn, \textsuperscript{1} Present address: Seeo Inc., 3906 Trust Way, Hayward, CA 94545

We have successfully prepared Graphene/FeSn\textsubscript{5} nanocomposite via a modified wet-chemistry process. FeSn\textsubscript{5} nanospheres have tetragonal phase in P4/mcc space group, which were not established in the existing Fe-Sn phase diagram (Figure 1a). The new FeSn\textsubscript{5}-phase nanospheres have the defect structure Fe\textsubscript{0.74}Sn\textsubscript{5}, whose 929 mAh g\textsuperscript{-1} theoretical capacity is the highest to date for the reported M (electrochemically inactive)-Sn intermetallic anodes in lithium ion batteries and the measured capacity can reach 750 mAh g\textsuperscript{-1}. However, the cycling performance of Fe\textsubscript{0.74}Sn\textsubscript{5} nanospheres became poor after 15 cycles because of the massive volume change in lithium insertion/extraction. Graphene can improve electrical conductivity and accommodate structural stress due to its superior chemical and mechanical properties.

In graphene/FeSn\textsubscript{5} nanocomposite, FeSn\textsubscript{5} nanoparticles with the size of 30-50 nm are encapsulated in graphene nanosheets (Figure 1b). The cell performance of graphene/FeSn\textsubscript{5} nanocomposite delivers excellent cycling stability. The reason could be that graphene sheets release the volume expansion and enhance electrical conductivity.

This work is supported by the “Strategic Priority Research Program” of the Chinese Project Academy of Science, GrantNo.XDA01020304, the National Natural Science Foundation of China (Grant No. 51371186), Ningbo 3315 International Team of Advanced Energy Storage Materials.

Figure 1. a) XRD pattern, and b) SEM image of graphene/FeSn\textsubscript{5} nanocomposite.