Controlled growth of Mo$_2$C pyramids on liquid Cu surface

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Abstract: Precise spatial control of 2D materials is the key capability of engineering their optical, electronic, and mechanical properties. However, growth of novel 2D Mo$_2$C on Cu surface by chemical vapor deposition method was revealed to be seed-induced 2D growth, limiting further synthesis of complex Mo$_2$C spatial structures. In this research, we demonstrate the controlled growth of Mo$_2$C pyramids with numerous morphologies, which are characterized with clear terraces within the structures. The whole evolution for Mo$_2$C pyramids in the course of CVD process has been detected, posing significant potential in probing growth mechanism. The formation of the Mo$_2$C pyramids arises from the supersaturation-induced nucleation and concentration-gradient driven diffused growth of a new Mo$_2$C layer on the edged areas of intrinsic ones, as supported by STEM imaging. This work provides a novel Mo$_2$C-based pyramid structure and further reveals a sliding growth mechanism, which could offer impetus for the design of new 3D spatial structures of Mo$_2$C and other 2D materials.

Key words: Mo$_2$C pyramids; liquid Cu; chemical vapor deposition

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Supporting Information

Fig. S1. (Color online) Optical images of large-area hexagonal pyramid Mo$_2$C structures on liquid Cu surface.
Fig. S2. (Color online) Raman mapping of Mo$_2$C pyramids structure.

Fig. S3. (Color online) Optical image of left layered hexagonal profile after transferring process.

Fig. S4. (Color online) Direct observation of growth intermediates for layered Mo$_2$C pyramid structures.

Fig. S5. (Color online) (a, b) Optical images of growth intermediates for hexagonal pyramid-like structures. (c) Schematic of the diagram illustrates the growth of hexagonal Mo$_2$C pyramid structures.