Nanoscale Patterning of 2D Materials Using Focused Ion Beam

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Focused Ion Beams (FIB) has been widely employed to cross-disciplinary applications ranging from the physical and life sciences to archaeology because of their capabilities of patterning features with nanoscale precision, which makes FIB a promising candidate for patterning 2D materials with tailored electronic or optoelectronic properties. Nevertheless, there have been no successful experimental application of patterning 2D materials using FIB, which remains a puzzle in the community of both 2D materials and FIB. In this study, we carried out a series of large-scale molecular dynamics simulations of FIB processes of graphene sheets supported by Cu substrate. Our simulation results indicate that sputtered Cu atoms from the substrate interior from collision cascade induced by energetic ion bombardment create numerous point defects in graphene. These point defects can be far from the ion beam slicing edges, which can potentially destroy the graphene sheets with desirable electronic/optoelectronic properties. We also demonstrate from MD simulations that it is possible to supress defect generation in 2D materials during FIB, which are currently undergone extensive experimental validation from our experimental colleagues in RCAS.

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