Title:	Graphene Ingestion and Regrowth on "carbon-Starved" Metal Electrodes
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Abstract:	The interaction between graphene and various metals plays a central role in future carbon-based device and synthesis technologies. Herein, three different types of metal nanoelectrodes (W, Ni, Au) were employed to in situ study the graphene–metal interfacial kinetic behaviors in a high-resolution transmission electron microscope. The three metals exhibit distinctly different interactions with graphene when driven by a heating current. Tungsten tips, the most carbon-starved ones, can ingest a graphene sheet continuously; nickel tips, less carbon starved, typically “eat” graphene only by taking a “bite” from its edge; gold, however, is nonactive with graphene at all, even in its molten state. The ingested graphene atoms finally precipitate as freshly formed graphitic shells encapsulating the catalytic W and Ni electrodes. Particularly, we propose a periodic extension/thickening graphene growth scenario by atomic-scale observation of this process on W electrodes, where the propagation of the underlying tungsten carbide (WC) dominates the growth dynamics. This work uncovers the complexity of carbon diffusion/segregation processes at different graphene/metal interfaces that would severely degrade the device performance and stability. Besides, it also provides a detailed and insightful understanding of the sp2 carbon catalytic growth, which is vital in developing efficient and practical graphene synthetic routes.
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