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Scalable production of pristine graphene using electrochemical exfoliation

In the electrochemical exfoliation method, an applied voltage drives ionic species to intercalate into graphite where they may form gaseous species that expand and exfoliate individual graphene sheets. However, a number of scientific obstacles have prevented this method from becoming a feasible manufacturing approach; the disintegration of the graphite electrode as the method progresses is the chief difficulty. Our data show that if graphite powders is contained and compressed within a permeable, expandable containment system, then these graphite powders can be continuously intercalated, expanded, and exfoliated to produce graphene at high yields. Our data indicate both high yield and extraordinarily large lateral size in the as-produced graphene, as shown by AFM, SEM, and optical microscopy. This process is scalable with no diminished efficiency in large sizes and parallel electrodes.

Figures

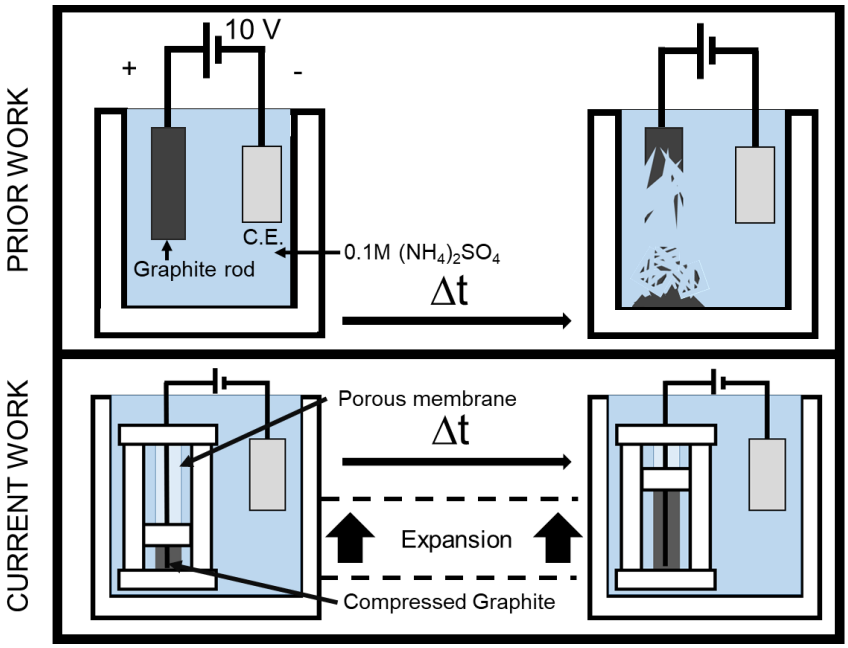

Figure 1: (top) Prior efforts to use electrochemical exfoliation have resulted in the graphite working electrode disintegrating during intercalation (C.E. denotes the counter electrode). (bottom) Schematic illustration of our process for electrochemical exfoliation of graphite flakes in a permeable expandable container.