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Aggregation modes of bottom-up synthesized graphene nanoribbons MIKHAIL SHEKHIREV, TIMOTHY VO, DONNA KUNKEL, Univ of Nebraska - Lincoln, FRANÇOIS ORANGE, MAXIME GUINEL, Univ of Puerto Rico, YU ZHAO, ALEXEY LIPATOV, RAFAL KORLACKI, XIAO ZENG, AXEL ENDERS, ALEXANDER SINITSKII, Univ of Nebraska - Lincoln — Graphene nanoribbons (GNRs) attract a great deal of attention because of their tunable electronic properties. It has been theoretically and experimentally that the band gap in GNRs is inversely proportional to the ribbons' widths. Narrow GNRs with atomically precise edges and large band gaps could be synthesized in bulk quantities by solution-based chemical methods. However, the properties of bulk and individual GNRs could be different due to aggregation effects. We study aggregation of solution-synthesized chevron-like GNRs in different conditions and demonstrate two types of GNR assemblies. In a solution, GNRs tend to form π-π stacked structures, which was shown experimentally using XRD and different microscopy techniques; these observations were supported by molecular dynamics simulations. But when deposited on a substrate, GNRs self-assemble in very different structures where individual ribbons are attached in a side-by-side fashion. These self-assembled nanostructures, which we refer to as GNR "nanobelts," were observed on different substrates, including polymers, mica and Si/SiO_2, and could be up several micrometers long. These GNR nanobelts can be visualized by conventional microscopy techniques (AFM, SEM, TEM) and used for fabrication of electronic devices. We will also discuss how different aggregation modes affect electronic and optical properties of bulk GNRs.

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