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Transport properties of high quality heterostructures from unstable 2D crystals prepared in inert atmosphere GELIANG YU, School of Physics and Astronomy, University of Manchester, CAO YANG, Centre for Mesoscience and Nanotechnology, University of Manchester, EKATERINA KHESTANOVA, ARTEM MISHCHENKO, School of Physics and Astronomy, University of Manchester, ANDY KRETININ, ROMAN GORBACHEV, Centre for Mesoscience and Nanotechnology, University of Manchester, KONSTANTIN NOVOSELOV, GEIM ANDRE, School of Physics and Astronomy, University of Manchester, MANCHESTER GROUP TEAM — Many layered materials can be cleaved down to individual atomic planes, similar to graphene, but only a small minority of them are stable under ambient conditions. The rest reacts and decomposes in air, which has severely hindered their investigation and possible uses. Here we introduce a remedial approach based on cleavage, transfer, alignment and encapsulation of airsensitive crystals, all inside a controlled inert atmosphere. To illustrate the technology, we choose two archetypal two-dimensional crystals unstable in air: black phosphorus and niobium diselenide. Our field-effect devices made from their monolayers are conductive and fully stable under ambient conditions, in contrast to the counterparts processed in air. $NbSe_2$ remains superconducting down to the monolayer thickness. Starting with a trilayer, phosphorene devices reach sufficiently high mobilities to exhibit Landau quantization. The approach offers a venue to significantly expand the range of experimentally accessible two-dimensional crystals and their heterostructures.

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