**One-dimensional van der Waals heterostructures**

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Recent success in van der Waals (vdW) heterostructures consisting of two dimensional (2D) crystals have resulted in interesting physics and potential applications. However, whether such artificial materials can exist in other dimensions remains an open question. Here we present the experimental discovery of one-dimensional (1D) vdW heterostructures, a class of new material where different atomic layers are coaxially (instead of planarly) stacked. We demonstrate a 5 nm diameter nanotube consisting of three different crystals: an inner carbon nanotube, a middle hexagonal boron nitride (BN) nanotube and an outer MoS2 nanotube. Different from previous attempts to build coaxial tubes, all shells of our heterostructure are single crystals, making this experimentally obtained structure as ideal as what is pictured in theoretical predictions. As the synthesis technique is highly applicable to other materials in the current 2D library, we expect a plethora of function-designable 1D heterostructures will appear using carbon, BN and transition metal dichalcogenide nanotubes as basic building blocks.