Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

A New One-dimensional Quantum Material - $Ta_2Pd_3Se_8$ Atomic Chain XUE LIU, JINYU LIU, JIN HU, CHUNLEI YUE, ZHIQIANG MAO, JIANG WEI, Tulane University, LIUBOV ANTIPINA, PAVEL SOROKIN, Technological Institute for Superhard and Novel Carbon Materials, ANA SANCHEZ, University of Warwick — Since the discovery of carbon nanotube, there has been a persistent effort to search for other one dimensional (1D) quantum systems. However, only a few examples have been found. We report a new 1D example - semiconducting $Ta_2Pd_3Se_8$. We demonstrate that the $Ta_2Pd_3Se_8$ nanowire as thin as 1.3nm can be easily obtained by applying simple mechanical exfoliation from its bulk counterpart. High resolution TEM shows an intrinsic 1D chain-like crystalline morphology on these nano wires, indicating weak bonding between these atomic chains. Theoretical calculation shows a direct bandgap structure, which evolves from 0.53eV in the bulk to 1.04eV in single atomic chain. The field effect transistor based on $Ta_2Pd_3Se_8$ nanowire achieved a promising performance with 10^4 On/Off ratio and 80 $cm^2V^{-1}s^{-1}$ mobility. Low temperature transport study reflects two different mechanisms, variable range hopping and thermal activation, which dominate the transport properties at different temperature regimes. $Ta_2Pd_3Se_8$ nanowire provides an intrinsic 1D material system for the study low dimensional condensed matter physics.

Xue Liu
Tulane University

Date submitted: 24 Nov 2015 Electronic form version 1.4