Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Electrostatic Screening of Charged Defects in 2D Materials TIMOTHY ATALLAH, Department of Chemistry, Columbia University, MELISSA BOSCH, Department of Physics and Astronomy, University of Minnesota, Twin Cities, JUE WANG, Department of Chemistry, Columbia University, DONGJEA SEO, Department of Mechanical Engineering, Columbia University, OSMAN MONEER, JUSTIN ZHU, Department of Chemistry, Columbia University, DEMI AJAYI, JENNY ARDELEAN, Department of Mechanical Engineering, Columbia University, HAIMING ZHU, Department of Chemistry, Columbia University, MONICA THEIBAULT, Department of Chemistry, University of California, Berkeley, JAMES HONE, Department of Mechanical Engineering, Columbia University, XIAOYANG ZHU, Department of Chemistry, Columbia University — Two dimensional (2D) semiconductors, such as transition metal dichalcogenides (TMDCs) monolayers, are an emerging class of materials that show promise in the development of highly efficient nanoscopic optoelectronic devices. A major factor hampering TMDC monolayers device performance is the inconsistent quality of TMDCs due to presence of defects/traps. Here we show that charged defects can be electrostatically screened/passivated. We find that contacting TMDC monolayers with an ionic liquid reduces charge carrier trapping and non-radiative recombination. This effect is reversible and can increase photoluminescence yield by as much as two-orders of magnitude while suppressing the photoluminescence emission from trions. We propose that the mobile ions electrostatically screen local charged vacancies within the TMDC monolayer, thus protecting excitons from scattering with the defect sites.

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Date submitted: 11 Nov 2016 Electronic form version 1.4