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Dynamics of Ion-Gating 2D Crystals Using a Solid Polymer Electrolyte HUA-MIN LI, BUCHANAN BOURDON, University of Notre Dame, YU-CHUAN LIN, JOSHUA ROBINSON, The Pennsylvania State University, ALAN SEABAUGH, SUSAN FULLERTON, University of Notre Dame, CENTER FOR LOW ENERGY SYSTEMS TECHNOLOGY (LEAST) TEAM — Ion-gating can significantly increase the static carrier density of graphene due to the formation of an electric double layer (EDL); however, the dynamics of ion-gating have not been extensively reported. A comprehensive understanding of ion dynamics is important because it establishes the timescales required to achieve EDL equilibrium, and directly affects the operating speed of devices and circuits employing electrolytic gates. Here, ion dynamics are measured on epitaxial graphene Hall-bar devices that are electrolytically gated with polyethylene oxide and lithium perchlorate. The time constants for EDL formation and dissipation are measured as a function of temperature. The measured formation time is slower than the dissipation time, because ion diffusion resulting from a concentration gradient must be opposed during EDL formation. These results quantitatively agree with COMSOL multiphysics simulations. EDL dissipation follows a stretched exponential decay described by the Kohlrausch-Williams-Watts (KWW) equation. The temperature-dependent relaxation times extracted from the KWW fit follow the Vogel-Fulcher-Tammann (VFT) temperature dependence. At temperatures approaching the glass transition temperature of the electrolyte, the relaxation times exceed several hours, demonstrating the long timescales over which the EDL can persist in the absence of a gate bias.

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