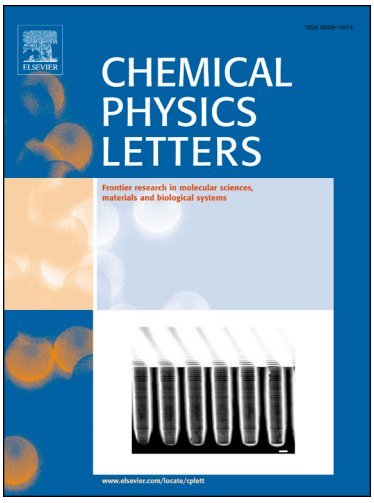

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The effects of dielectric decrement and finite ion size on differential capacitance of electrolytically gated graphene

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Abstract

We analyze the effects of dielectric decrement and finite ion size in an aqueous electrolyte on the capacitance of a graphene electrode, and make comparisons with the effects of dielectric saturation combined with finite ion size. We first derive conditions for the cross-over from a camel-shaped to a bell-shaped capacitance of the diffuse layer. We show next that the total capacitance is dominated by a V-shaped quantum capacitance of graphene at low potentials. A broad peak develops in the total capacitance at high potentials, which is sensitive to the ion size with dielectric saturation, but is stable with dielectric decrement.

Keywords: graphene, capacitance, electrolyte, dielectric decrement, steric effects

1. Introduction

Graphene has found many applications in electronics and photonics, but in recent years, a new application of graphene-based devices for biochemical sensing has materialized [1, 2, 3]. Typically, graphene-based sensors function as a field effect transistor (FET), where a single sheet of graphene acts as the conducting channel and is in contact with a liquid electrolyte [4]. Since graphene

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