

## Accepted Manuscript

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

Lindsey Daniels, Matthew Scott, Z.L. Mišković

PII: S0009-2614(18)30315-4  
DOI: <https://doi.org/10.1016/j.cplett.2018.04.030>  
Reference: CPLETT 35586

To appear in: *Chemical Physics Letters*

Received Date: 21 January 2018  
Accepted Date: 13 April 2018

Please cite this article as: L. Daniels, M. Scott, Z.L. Mišković, The effects of dielectric decrement and finite ion size on differential capacitance of electrolytically gated graphene, *Chemical Physics Letters* (2018), doi: <https://doi.org/10.1016/j.cplett.2018.04.030>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



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

Lindsey Daniels<sup>a</sup>, Matthew Scott<sup>a</sup>, Z. L. Mišković<sup>a,b,\*</sup>

<sup>a</sup>*Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1*

<sup>b</sup>*Waterloo Institute for Nanotechnology, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1*

---

## 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  
5 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

---

\*Corresponding author

*Email address:* [zmiskovi@uwaterloo.ca](mailto:zmiskovi@uwaterloo.ca) (Z. L. Mišković)

Download English Version:

<https://daneshyari.com/en/article/7837694>

Download Persian Version:

<https://daneshyari.com/article/7837694>

[Daneshyari.com](https://daneshyari.com)