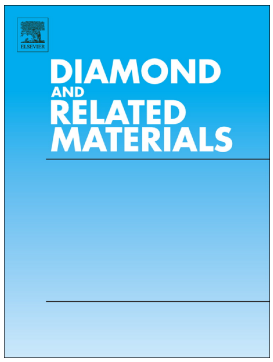

Effect of surface roughness and H–termination chemistry on diamond's semiconducting surface conductance

T. Wade, M.W. Geis, T.H. Fedynyshyn, S.A. Vitale, J.O. Varghese, D.M. Lennon, T.A. Grotjohn, R.J. Nemanich, M.A. Hollis

PII: S0925-9635(17)30135-8
DOI: doi: 10.1016/j.diamond.2017.04.012
Reference: DIAMAT 6864

To appear in: *Diamond & Related Materials*

Received date: 21 March 2017
Revised date: 9 April 2017
Accepted date: 10 April 2017

Please cite this article as: T. Wade, M.W. Geis, T.H. Fedynyshyn, S.A. Vitale, J.O. Varghese, D.M. Lennon, T.A. Grotjohn, R.J. Nemanich, M.A. Hollis , Effect of surface roughness and H–termination chemistry on diamond's semiconducting surface conductance. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Diamat(2017), doi: 10.1016/j.diamond.2017.04.012

Effect of Surface Roughness and H –Termination Chemistry on Diamond's Semiconducting Surface Conductance

T. Wade[1], M. W. Geis[1], T. H. Fedynyshyn[1], S. A. Vitale[1], J. O. Varghese[1], D. M. Lennon[1], T. A. Grotjohn[2], R. J. Nemanich[3], M. A. Hollis[1]

[1]Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, MA, United States.
[2]Electrical and Computer Engineering, Michigan State University, East Lansing, MI, United States.
[3]Physics, Arizona State University, Tempe, AZ, United States.

Keywords: Diamond, Hydrogen-termination, Molecular adsorption, Hole channel
Corresponding authors: Travis.Wade@LL.mit.edu and Geis@LL.mit.edu

Abstract

The H-terminated surface of diamond when activated with NO_2 produces a surface conduction layer that has been used to make FETs. Variations in processing can significantly affect this conduction layer. This article discusses the effect of diamond surface preparation and H termination procedures on surface conduction. Surface preparations that generate a rough surface result in a more conductive surface with the conductivity increasing with surface roughness. We hypothesize that the increase in conductance with roughness is the result of an increase of reactive sites that generate the carriers. Roughening the diamond surface is just one way to generate these sites and the rough surface is believed to be a separate property from the density of surface reactive sites. The presence of C in the H_2 plasma used for H termination decreases surface conductance. A simple procedure for NO_2 activation is demonstrated. Interpretation of electrical measurements and possible alternatives to activation with NO_2 are discussed. Using Kasu's oxidation model for surface conductance as a guide, compounds other than NO_2 have been found to activate the diamond surface as well.