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Abstract

TITLE: Diamond:H/Transition Metal Oxides Transfer-Doping Efficiency and Transistors Performance
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ABSTRACT BODY:

Abstract Body: Transfer doping of hydrogen terminated diamond (Diamond:H) with various molecular-like surface acceptors suffers from low efficiency and temperature instability. In contrast, high electron affinity transition-metal oxides (TMOs) (i.e. MoO_3, WO_3, V_2O_5 and ReO_3), when employed as surface acceptors for transfer doping on Diamond:H, have recently yielded improved p-type sheet conductivity and remarkable thermal stability even with only a few monolayers of coverage[1-4].

Despite these properties, the realization of Diamond:H electronic devices using TMOs remains very challenging[5,6]. This is due to undesirable changes in the physical and electronic characteristics of the TMO caused by the device fabrication process. In particular, stoichiometry reduction, crystalline phase transitions and structural morphology aggregations take place.

In this work, we will discuss how different TMOs' physical parameters affect the electrical properties of the resulting diamond:H/TMO-based transistors, and how these undesirable effects can be minimized. Electrical and surface characterization monitored before and after transistor fabrication reveal TMO oxygen reduction and a change in its oxidation state leading to electrical conductivity degradation. Based on these findings, we propose and demonstrate a way to improve diamond:H/TMO transistor performance and stability.

Keywords: Diamond, Surface Electrical Conductivity, P-type Doping, Surface Transfer Doping, Transition-Metal Oxides

References:
1. Russell et.al. Appl. Phys. Lett., vol. 103, no. 20, pp. 2–6, 2013.
2. Tordjman et.al. Adv. Mater. Interfaces, vol. 1, no. 3, pp. 1–6, 2014.
3. Crawford et.al. Appl. Phys. Lett., vol. 108, no. 4, pp. 1–5, 2016.
4. Tordjman et.al. Appl. Phys. Lett., pp. 1–13, 2017.
5. Vardi et.al. IEEE Electron Dev. Lett. 35, 12, 2014.
6. Yin & Tordjman et.al. IEEE Electron Dev. Lett. 39, 4, 2018.