Diamond CMOS technology

Meiyong Liao, Wen Zhao, and Satoshi Koizumi

National Institute for Materials Science, Tsukuba, Ibaraki 305-0044, Japan
meiyong.liao@nims.go.jp

The current silicon complementary metal-oxide-semiconductor (CMOS) technology has been facing bottlenecks in the conditions of high-power density, high frequency, high temperature, and strong radiation. Diamond CMOS has long been pursued to achieve performances beyond the capability of conventional silicon electronics. By using diamond electronics, not only can the thermal management demands for conventional semiconductors be alleviated but these devices are also more energy efficient and can endure much higher breakdown voltages and harsh environments. On the other hand, with the development of diamond growth technologies, power electronics, spintronics, and microelectromechanical system (MEMS) sensors operatable under high-temperature and strong-radiation conditions, the demand for peripheral circuitry based on diamond CMOS devices has increased for monolithic integration.

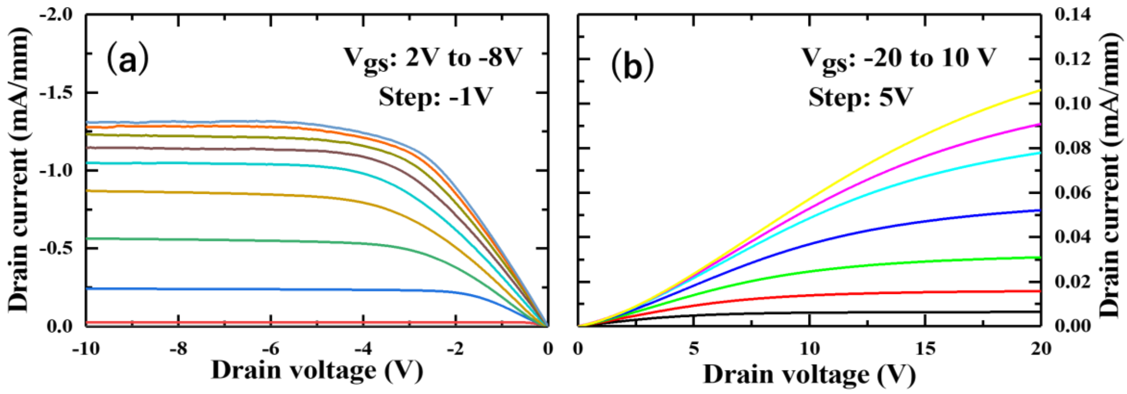

Fig.1 Diamond CMOS technology: transistor properties of (a) p-channel MOSFET (RT) and (b) n-channel MOSFET (573K).

In this talk, we present the development of both p-channel diamond MOS field-effect transistor (MOSFET) and n-channel MOSFET on phosphorous-doped n-type diamond epilayers with similar donor concentrations [1,2], as shown in Fig.1. The n-MOSFET was formed on the oxidized diamond surface, while the p-MOSFET was fabricated on the n-type diamond with hydrogen-terminated surface. The successful formation of both n-channel and p-channel MOSFETs on the n-type diamond wafer provides the route for the development of diamond CMOS circuits.

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References

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