**PLASTICITY AND SIZE EFFECTS IN GERMANIUM: FROM CRYOGENIC TO ELEVATED TEMPERATUTRES**

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Key Words: plasticity, size effect, micro-compression, cryogenic testing

Germanium is extensively used as a substrate in functional components of devices and microelectromechanical systems (MEMS) because of its tunable band structure and carrier mobility via. strain engineering [1]. The mechanical properties of Ge with a diamond-cubic structure at such small scales, i.e. in range of micro/nano-meter, are expected to be extraordinary since the improved strength and ductility of brittle crystals with minimized geometries [2]. Recent advances in nano-mechanical testing systems enable the investigation of the size- and temperature-dependent deformation behaviors and relevant parameters [3].

In the present study, micro-compression of FIB-machined micropillars is conducted to obtain a thorough understanding of the plasticity and size effects of Ge from cryogenic to elevated temperatures, i.e. in the range of -100°C to 600°C, shown in Figure 1(a). Dislocation motion in Ge is quantitatively evaluated as a function of sample size and crystalline orientation at the low temperature regime. Furthermore, the brittle-to-ductile transition is investigated to study the transition of deformation mechanisms, i.e. full to partial dislocation motion on the glide set, at the elevated temperatures regime [4]. Deformed regions in micropillars are subsequently characterized using HRTEM to track dislocations and microtwins. An unambiguous interpretation of dislocation processes in the diamond-cubic structure will be presented.

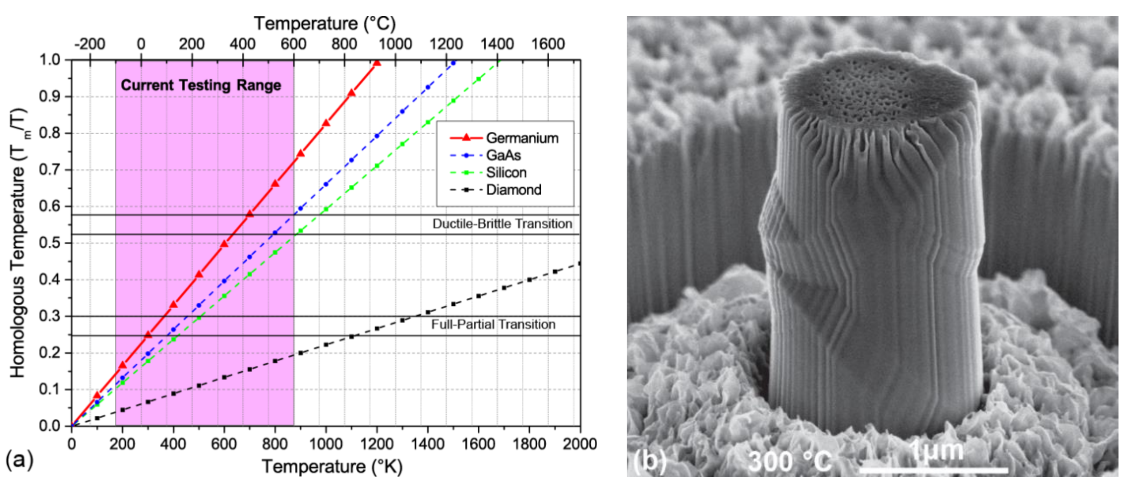


*Figure 1 - (a) Temperature range of micro-compression testing in Ge and other semiconductors; (b) Secondary electron micrograph of Ge micropillar compressed at 300°C.*

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