초청강연

Nanosilicon Technology

Nobuyoshi KOSHIDA
Tokyo University of A & T, Koganei, Tokyo 184-8588, Japan
Tel: (0)42-388-7128, Fax: (0)42-385-5395, E-mail: koshida@cc.tuat.ac.jp

It is shown that the usefulness of single crystalline silicon should be amplified by the quantum properties of nanocrystalline silicon (nc-Si) [1]. As summarized in **Fig.1**, many possibilities can be pursued towards new advanced silicon technology.

One of the most striking quantum effects induced in nc-Si is visible luminescence and related optoelectronic functions. The oxide-free nc-Si samples that emit the red, green, and blue light under UV excitation has been sucessfully prepared only by size control. To date, we have renovated top data of the EL quantum efficiency[2]. The implementation of monolithic photonic devices such as waveguide, nonlinear device, and microcavity is also an important accomplishment. The nc-Si diode operates as an efficient cold electron source. In the device with an optinized nc-Si structure, the electron emission mode becomes ballistic. The main advantages of this cold cathode are: surface-emissive, energetic emission with a small angular dispersion, insensitivity to vacuum pressure, low-voltage operation, and quick response. Using this emitter as an excitation source we have developed a vaccuum-type flat-panel display as shown[3]. The solid-state luminescent device can be obtained by using ballistic electrons without ejecting into vacuum[4]. Making the best use of an extremely low thermal conductivity in nc-Si, it becomes possible to fabricate an efficient ultrasonic emitter based on thermo-acoustic conversion[5]. The nc-Si ultrasound generator has several advantageous features: emission without any mechanical vibrations, flat frequency response in a wide band, availability of scaling merits for enhancing efficiency. Basic studies for application of this emitter are intensively conducted for developing silicon-based new ultrasonic technology.

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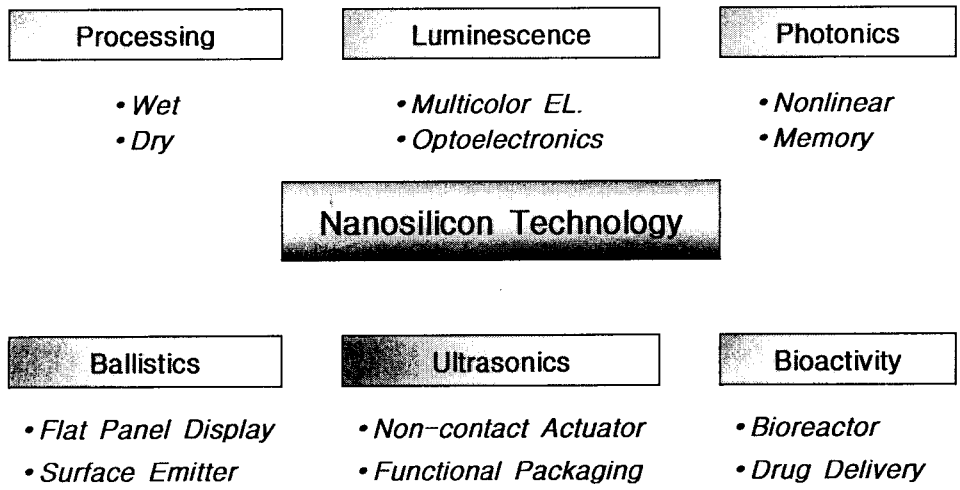

Fig.1. Technological potential of quantum-sized nc-Si.