

Green Nanotechnology

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Energy and environmental issues are becoming critical for human beings to realize a sustainable society. Global warming due to the increase of the green house gas emission is one of the most serious ones in the energy and environmental issues. Explosion of information traffic in the internet brings about the drastic increase of electric power consumption of the computing and communication systems, in particular, those at data centers, accelerating the increase of CO₂ gas emission. It is now very important to develop energy-saving technology for those systems. Miniaturization of semiconductor devices according to Moore's law has worked well so far, which has contributed the reduction of their electric power consumption significantly.

However, we are facing serious difficulties in the miniaturization of the semiconductor devices, approaching the miniaturization limit technically and economically. Technological innovations are required in the electronic devices when we are entering the so-called nanoelectronics era.

In the presentation, attempts to develop nanoelectronic devices with non-volatile operating capabilities, which are key features to reduce the power consumption of electronic systems, will be addressed. Photonics is also an important technology to realize higher performance and lower power consumption in the computing and communication systems. Si nanophotonic devices where miniaturized photonic devices are integrated on a Si chip by confining light beam in wavelength or even sub-wavelength structures become feasible owing to the progress of nanofabrication technology in the advanced Si LSIs. In the presentation, recent developments of Si nanophotonic devices will be addressed.

The computing and communication systems whose performances are boosted by the progress of nanoelectronic and nanophotonic devices have potential to change our life-style, resulting in far larger energy saving than the energy consumption of those systems. At the end of the presentation, the future view of a sustainable information society will be addressed.