[Invited talk] Single-walled carbon nanotube devices exhibiting collective stochastic resonance

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We aimed to develop a single-walled carbon nanotube (SWNT)-based stochastic resonance (SR) device, in which large number of SWNT individual junctions is one of the requirement to obtain pronounced SR effect. We observed SR effect in SWNT device by adding the noise to detect small input signal, in which the device utilize molecular junction between metal and SWNT to provide non-linear response. Our main concern is development of an SR device which has its own noise source by SWNT functionalization using molecule which has active redox site. Charge fluctuation in the molecules will affect the conductivity of SWNT as a noise, which is independent for each SWNT. Our preliminary results show that the use of molecule-functionalized SWNT provide different noise characteristic than that of pristine SWNT device.

We also develop a way to control the fabrication technique of SWNT devices using bottom contact electrodes via solution process. SWNT devices that are fabricated via solution casting have an advantage to separate metallic and semiconducting SWNTs and to use functionalized SWNTs. We demonstrated that the number of SWNT direct junctions is drastically increased by using flattened electrodes, and realize better ambipolarity. Bending of the SWNTs results in a higher Schottky barrier for the electrons due to shifting of the Fermi level of SWNT. The fluctuations in nano-materials and nonlinear response at the atomically scale molecular junctions should be utilized in novel technology in near future.

References

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