Bucky gel actuators from chemically modified super growth CNTs and CNT/PPy composites

Alberto Ansaldo [1], Maurizio Biso[1], Elisa Picardo[2], Luca Ceseracciu[3], Don N. Futaba[4], Kenji Hata[4], Alberto C. Barone[3], Davide Ricci[1]

[1] *Robotics, Brain and Cognitive Sciences Department, Istituto Italiano di Tecnologia, Genova*

[2] *Dipartimento di Ingegneria Biofisica ed Elettronica, Università di Genova, Genoa, Italy*

[3] *Nanophysics, Istituto Italiano di Tecnologia, Genova, Italy*

[4] *Nanotube Research Center, National Institute of Advanced Industrial Science and Technology, Ibaraki, Japan*

Bucky gel actuators are attractive because they can operate at low voltage in air with promising frequency and strain performance, which can be significantly improved by a combination of physical and chemical modifications together with appropriate engineering. We showed that it is possible to increase the performance of such actuators by cross-linking carbon nanotubes (CNTs) with an aromatic diamine (PPD). Here we present novel results obtained cross-linking super growth CNTs by a cyclic aliphatic diamine (DCH). Moreover we demonstrate that it is possible to synthesize PPy on the surface of the jellified CNTs by using $AuCl_3$ as oxidant in ionic liquid medium and this leeds to the fabrication of actuators that, compared to pure CNT based ones, display a maximum strain up to five times larger. Another limit of existing technology for bucky gel artificial muscles is their bimorph configuration. We designed a novel three electrode actuator capable of both linear and bending motion. Finally, we propose a way to model actuation performance in terms of purely material-dependent parameters instead of geometry-dependent ones. Our latest results will be discussed.