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Author(s)	Tanaka, Yasuhiko; Hirana, Yasuhiko; Niidome, Yasurou; Nakashima, Naotoshi
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Determination of Redox Potentials of Single-walled Carbon Nanotube by Using Spectroelectrochemistry

Yasuhiko Tanaka¹, Yasuhiko Hirana¹, Yasurou Niidome¹, and Naotoshi Nakashima^{1,2,*}

¹Department of Applied Chemistry, Graduate School of Engineering,
Kyushu University, 744 motooka, Fukuoka 819-0395, Japan

²JST-CREST, 5 Sanbancho, Chiyoda-ku, Tokyo 102-0075, Japan

*Tel & Fax: +81-92-802-2840, E-mail: nakashima-tcm@mail.cstm.kyushu-u.ac.jp

Ever since the discovery of single-walled carbon nanotubes (SWCNTs), many groups have endeavored to understand the fundamental properties of the CNTs. The redox properties (i.e. electronic densities, the Fermi levels, redox potentials) of SWCNTs are related to the structures of SWCNTs that have a specified diameter and chirality angle uniquely related to a pair of integers (n,m); i.e., the so-called chiral indices.^[1] Many attempts have been made to determine the electronic properties of SWCNTs^[2-7] however, the achieved success in the determination of the redox properties as already reported has been low. Here we describe a simple method for the determination of the redox potentials of several individual (n,m)SWCNTs using near-IR PL spectroelectrochemistry.

Strategic approaches toward the solubilization of SWCNTs are essential for many applications of SWCNTs^[8] and numerous dispersants including carboxymethylcellulose sodium salt (CMC)^[9] have been used to individually dissolve SWCNTs. In this study, we fabricated a non-fluorescent transparent indium tin oxide (ITO) electrode modified with a cast film of CMC/poly(diallyldimethylammonium chloride) (PDDA) that contained isolated SWCNTs.

We have discovered that we can determine the redox potentials of isolated SWCNTs having their own chirality indices by in situ near-IR PL spectroelectrochemistry at the fabricated modified ITO electrode. This has been achieved by using this modifying film that retains the isolated SWCNTs and the spectroelectrochemical results analyzed by regression analysis^[10].

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