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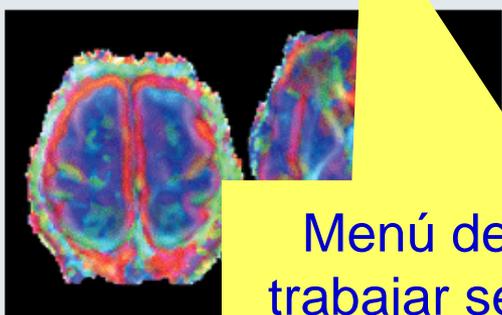
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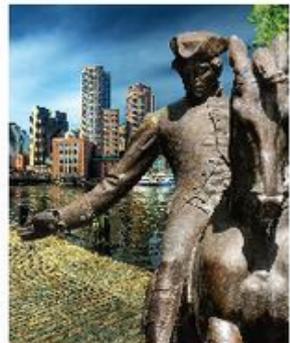
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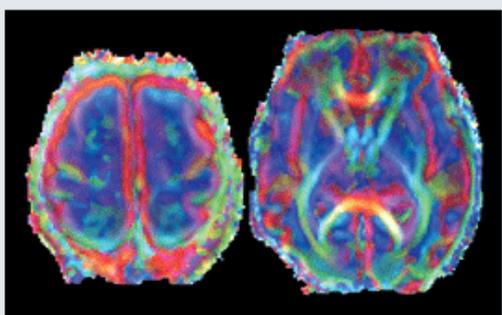
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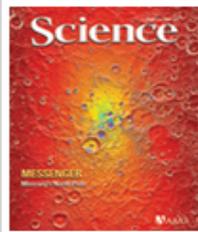
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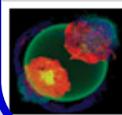
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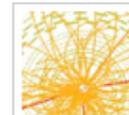
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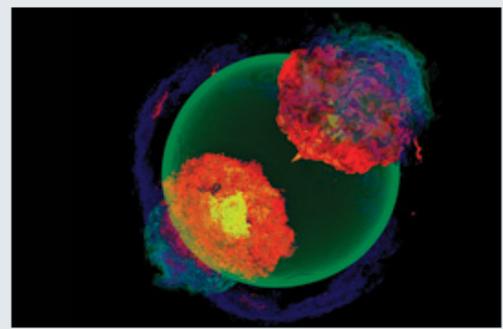
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REPORT

Oxygen Doping Modifies Near-Infrared Band Gaps in Fluorescent Single-Walled **Carbon Nanotubes**

Saunab Ghosh¹, Sergei M. Bachilo¹, Rebecca A. Simonette², Kathleen M. Beckingham², R. Bruce Weisman^{1,2}

 Author Affiliations

 To whom correspondence should be addressed. E-mail: weisman@rice.edu

ABSTRACT

Controlled chemical modifications of single-walled **carbon nanotubes** (SWCNTs) that tune their useful properties have been sought for multiple applications. We found that beneficial optical changes in SWCNTs resulted from introducing low concentrations of oxygen atoms. Stable covalently oxygen-doped nanotubes were prepared by exposure to ozone and then light. Treated samples showed distinct, structure-specific near-infrared fluorescence at wavelengths 10 to 15% longer than displayed by pristine semiconducting SWCNTs. Dopant sites harvest light energy absorbed in undoped nanotube regions by trapping mobile excitons. Oxygen-doped SWCNTs are much easier to detect and image than pristine SWCNTs because they do not absorb at the shifted emission wavelength.

One of the key properties of single-walled **carbon nanotubes** (SWCNTs) is their diversity of well-defined structures (1, 2). Each SWCNT is composed of covalently bonded carbon atoms with a specific diameter and roll-up angle, uniquely defined by a pair of integers called the (n,m) index. About two-thirds of SWCNT structures are semiconducting. Their intrinsic band gaps are determined by quantum confinement and linked to physical structure, with only slight alterations possible through environmental perturbation.

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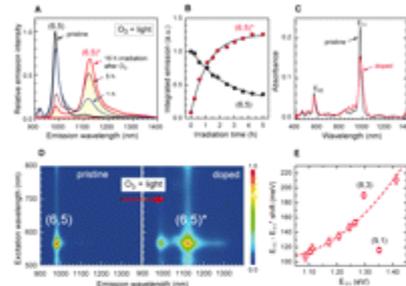
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Fig. 1

Spectral changes in a (6,5)-enriched SWCNT dispersion exposed to ozone and light. (A) Emission spectra measured with 785-nm excitation after a single treatment with ozone and 1 to 16 hours of white-light irradiation. (B) Spectrally integrated emission under the (6,5) main band (black) and side band (red) versus irradiation time with a desk lamp. (C) Absorption spectra (path length 1 cm) of the SWCNT sample before (black) and after (red) treatment with ozone and light. (D)

Photoluminescence excitation-emission contour plots from the (6,5)-enriched sample before and after treatment. The (6,5)* emission feature shows the same excitation peak wavelength as the (6,5) feature. (E) Measured photon energy difference between the unshifted and shifted fluorescence peaks of 10 different bulk (n,m) species as a function of unshifted emission energy. Points show experimental data; the dashed line is a quadratic function drawn to the eye. Two points far from the line are labeled with their (n,m) values.

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- 1. Operador AND = ALL of this words
- 2. Operador OR = ANY of this words
- 3. Comillas = This exact phrase
- 4. Comodines - child*, child?,
 - Asterisco (*) – representa cero o más caracteres
 - Interrogación (?) – representa cualquier uno carácter
- 5. Stemming – para expandir la búsqueda utilizando las raíces de las palabras, es automático en la plataforma de Science

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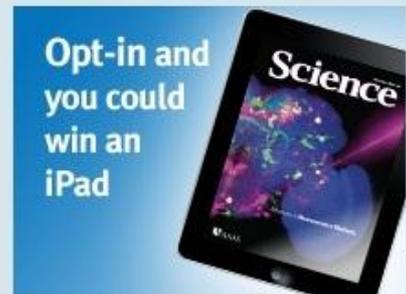
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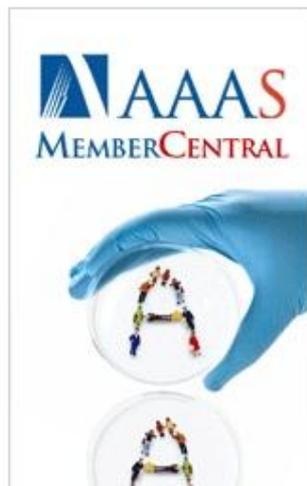
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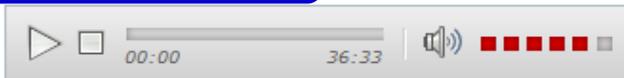
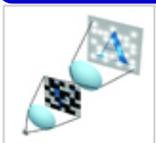
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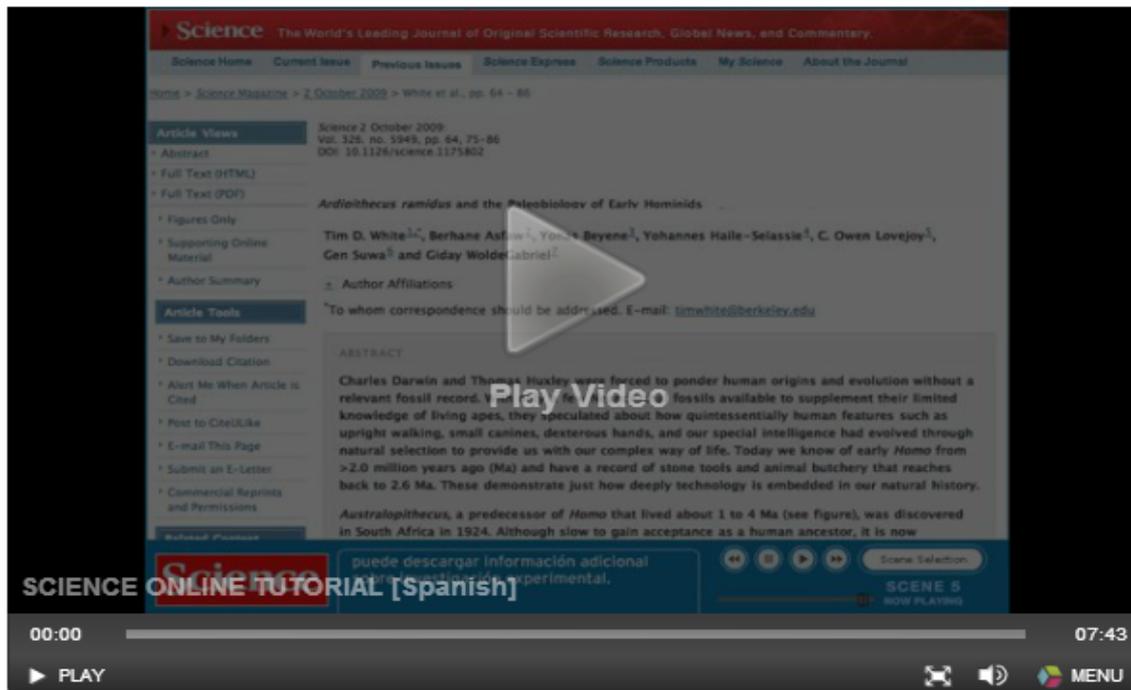
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Ardipithecus ramidus and the Paleobiology of Early Hominids

Tim D. White^{1,2}, Berhane Asfaw¹, Yohannes Beyene¹, Yohannes Haile-Selassie¹, C. Owen Lovejoy³, Gen Suwa⁴ and Giday WoldeGabriel²

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ABSTRACT
 Charles Darwin and Thomas Huxley were forced to ponder human origins and evolution without a relevant fossil record. Modern paleoanthropologists have used the fossils available to supplement their limited knowledge of living apes, they speculated about how quintessentially human features such as upright walking, small canines, dexterous hands, and our special intelligence had evolved through natural selection to provide us with our complex way of life. Today we know of early *Homo* from >2.0 million years ago (Ma) and have a record of stone tools and animal butchery that reaches back to 2.6 Ma. These demonstrate just how deeply technology is embedded in our natural history. *Australopithecus*, a predecessor of *Homo* that lived about 1 to 4 Ma (see figure), was discovered in South Africa in 1924. Although slow to gain acceptance as a human ancestor, it is now

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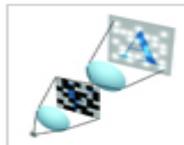
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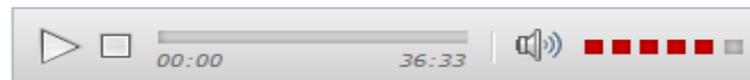
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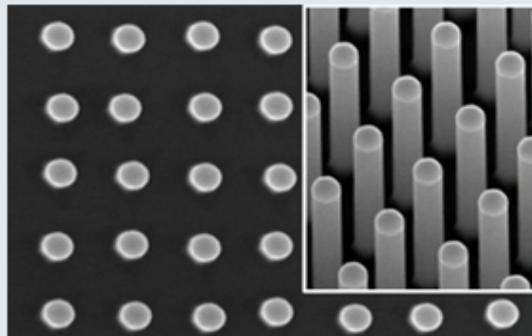
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