Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Superplastic single-walled carbon nanotubes J.Y. HUANG, S. CHEN, Z. WANG, K. KEMPA, S.H. JO, Department of Physics, Boston College, Chestnut Hill, MA 02467, Y.M. WANG, Lawrence Livermore National Laboratory, Livermore, CA 94550, G. CHEN, Department of Mechanical Engineering, MIT, Cambridge, MA 02139, M.S. DRESSELHAUS, Department of Physics, Electrical Engineering and Computer Science, MIT, Cambridge, MA 02139, Z.F. REN, Department of Physics, Boston College, Chestnut Hill, MA 02467 — Theoretical prediction on the maximum achievable tensile strain of a single-wall carbon nanotube (SWCNT) is less than 20%, but experiments indicate a much lower attainable strain of less than ~6%. Here we report that, at temperatures of above 2000 $^\circ$C, SWCNTs deform superplastically, with a tensile elongation to failure nearly 280%, and a diameter reduction of fifteen times. With this remarkable dimension change, the electronic property changes correspondingly from a metal with a pseudogap to a semiconducting state with a tunable gap up to 2 eV. Such superplastic deformation originates from plastic deformation mechanism dominated by the nucleation and motion of the kinks as well as atom diffusion in SWCNTs at high temperatures. Variable range hopping conduction is observed in the localized state due to scattering by point defects and kinks in the quasi-one-dimensional system.

Z.F. Ren
Department of Physics, Boston College, Chestnut Hill, MA 02467

Date submitted: 28 Nov 2005 Electronic form version 1.4