DIRECTION DES SCIENCES DE LA MATIERE,
INSTITUT RAYONNEMENT MATIÈRE DE SACLAY

SERVICE DE PHYSIQUE ET DE CHIMIE DES SURFACES ET DES INTERFACES

SEMINAIRE *

Lundi 22 juin 2009 à 11h00

Bâtiment 466, salle 111 - CEA Saclay, 91191, Gif sur Yvette

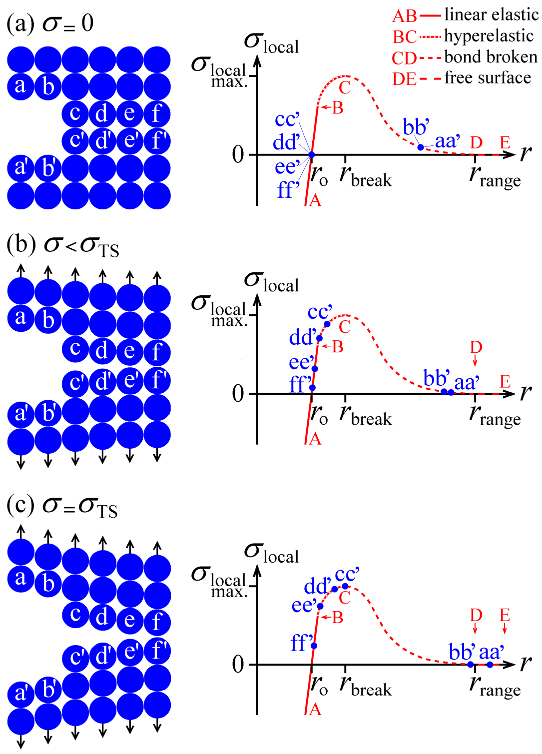
Tensile strength and fracture toughness of brittle materials considering and connecting microstructure and atomicity

Prof. Francisco G. Emmerich

Laboratory of Carbon and Ceramic Materials, **Universidade Federal do Espirito Santo, Brazil**

Invité par Cindy Rountree

This work addresses the fracture properties of brittle materials under tension by using a force-atomistic approach: we analyze the forces that act in the solid down to the smallest characteristic dimensions between the atoms or unit cells (or grains), discussing from fundamental principles the criterion for brittle fracture initiation. We take into account the forces due to the applied stress and the material cohesion forces, particularly at the crack tip, where the local hyperelasticity of the material plays a governing role, analyzing the minimum characteristic length scale around the point where the fracture begins. We connect microstructure and atomicity by using the concept of a total stress concentration factor, equivalent to a local resultant force, which can be obtained through the interaction of two multiplicative terms. By using an experimentally proved maximum tensile-stress criterion of bond rupture, based on the satisfaction of the static equilibrium condition given by Newton's second law up to the beginning of the rupture, we obtain a general expression for the tensile strength, which can be simplified through an effective local cohesive stress. By using the approximation of the stress concentration factor obtained from the concept of equivalent ellipse, we obtain expressions for the tensile strength and fracture toughness. Thus, we explain in a unified framework from fundamental principles a set of established experimental results of brittle fracture of materials under tension, including the dependence of the tensile strength on the crack tip radius of curvature, and some scatter in reported values of fracture toughness and cleavage surface energy. This work can be useful to make more realistic predictions of fracture properties of brittle materials taking into account microstructure and atomicity. It also points out some inadequacies in Griffith theory (1920) and discusses possible dangers in terms of structural safety.



*** SERA PRECEDE D'UNE PAUSE-CAFE A PARTIR DE 10H30**

<u>Formalités d'entrée</u> : Contacter le secrétariat pour l'établissement de votre autorisation d'entrée sur le centre de Saclay. Tél : 01.69.08.65.32 ou 01.69.08.40.12; Fax : 01.69.08.40.44 ; e-mail : catherine.julien@cea.fr. Le délai minimum est de …ires pour les visiteurs ressortissants des pays de l'Union Européenne, et de huit jours pour les autres. Sans autorisation, vous ne pourrez entrer sur le centre de Saclay. Dans tous les cas, se munir d'une pièce d'identité.