What is stress? Is stress a physical quantity?(second section)

Let us re-consider an example for metal foam as show n Figures 1(a,b) that show the local flexuosity under cycle compression loading. Previous researchers used the effective elastic moduli theory and the effective stress concept to study this kind of problem. However, who know what are the approximate stresses at any point in the form, say, at the points A, B, A', B'? Even though the irregularly located holes are large as in mm scale, it is still impossible and unnecessary to measure the stresses on each hole's surface. Some researchers used Figure 1(b) in 2D space to model the deformation of the metal foam but they should still use some constitutive relations between the strain and the stress. No one could measure the stress distribution on each point of a prescribed hole's surface but I could measure the displacements and strains at the same point, using the GOM instruments or device.

再举个金属铝蜂窝材料的例子。图一(a,b) 显示，这类材料试件在压力下的局部屈曲。研究者能够计算的是这个材料试件的等效刚度（人为建立本构关系，可以有各种各样的）、等效应力（由本构关系推算），但是，谁能计算图中的 A、B、A'、B'质点上的应力数值呢？即不可能，也无必要。有人用 2D 模型来计算这个金属泡沫试件的变形，但是没有人能够测量一个指定的孔洞表面的应力分布，即使这些孔洞是在毫米范围大小。

(a) 5 mm
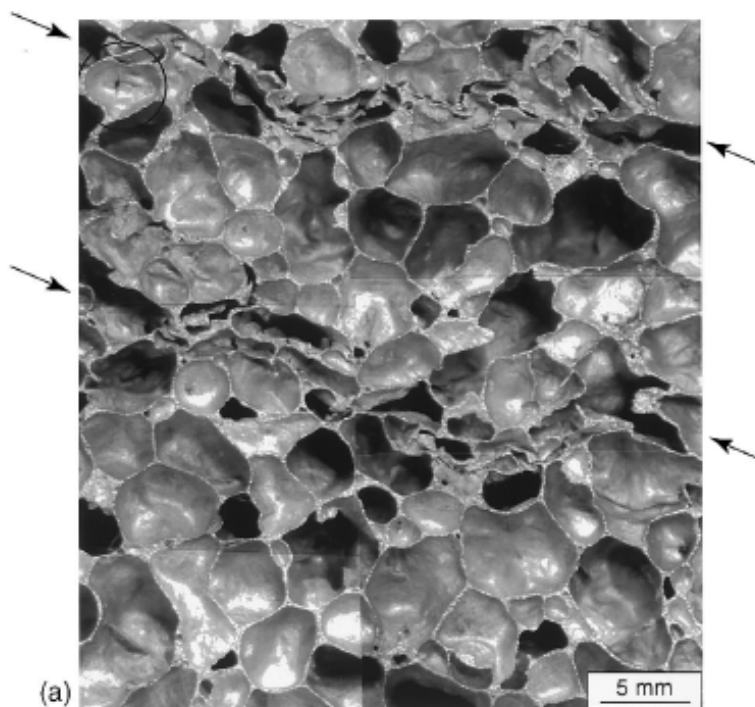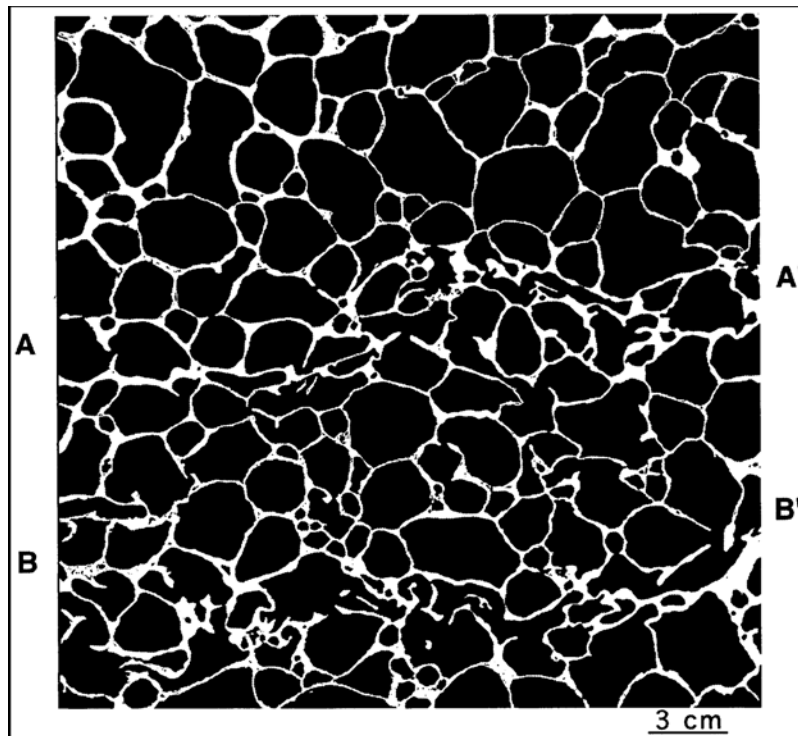
图一、金属铝蜂窝材料的压力载荷下局部屈曲：(a) 照片，箭头是局部屈曲位置；(b)数字计算模拟，A、B、A'、B'四点是屈曲位置的两边界点（引自网络）。

Figure 1 local flexuosity of a metal foam specimen under a cycle compression loading: (a) Photo after the local flexuosity; (b) Four boundary points of the local flexuosity A、B、A'、B' attached from website.

As so many researchers doubt and reject my viewpoint reported in my first paper of iMechanica blog, I would like to show them these two figures which do support my opinion. That is, all strain-displacement fields in Figure 1(b) could be measured by the GOM device and could be calculated by using ABQUS, but without the constitutive relation from a man's brain, no one could calculate the stress field in the *solid body* or *white region* of Figure 1(b) whereas the *black body* is full of air.

Some one (Dr. Jayadeep) asked me to answer the question: Do you consider pressure as a physical quantity? How about surface tractions; are they physical quantities?

It is obvious if he see the figure 1(a).

That is, the air/water pressure is of course a physical quantity that is applied on the metal foam, say, 1-5MPa, which could certainly be measured without any difficulty. However, which device could be used to measure the stress along each thin white curve?

Indeed, the stress at any point/region along each thin white curve depends on the constitutive relation selected although the displacement and the strain could be measure. Some points along each thin white curve might be within the elastic state, whereas other points along a different location of the same thin curve might be within elastic-plastic state. So, different selections of the constitutive relations would yield
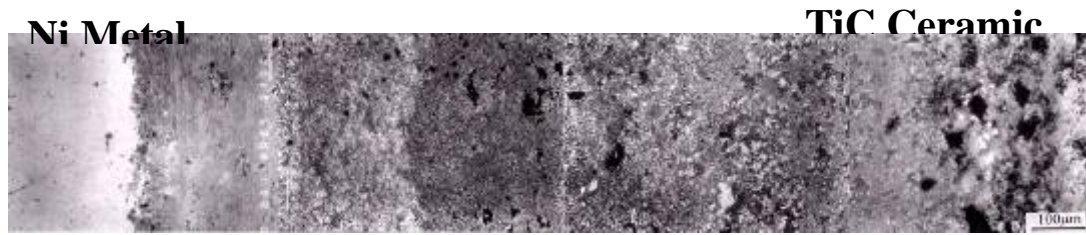
quite different stresses!

Ni Metal   **TiC Ceramic**

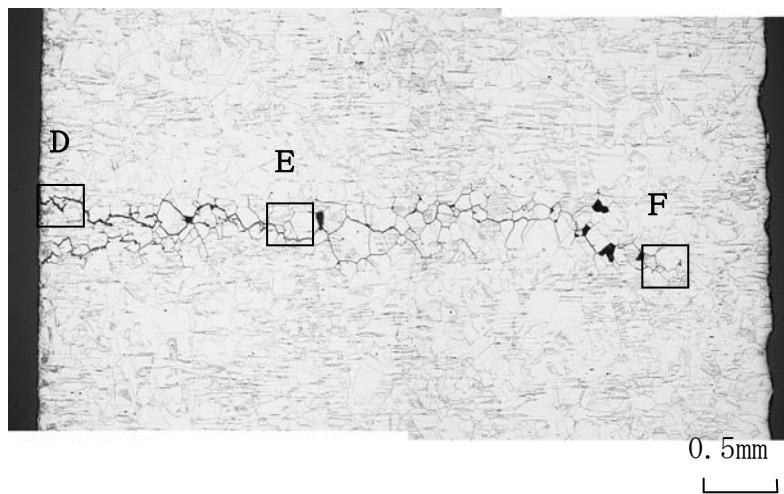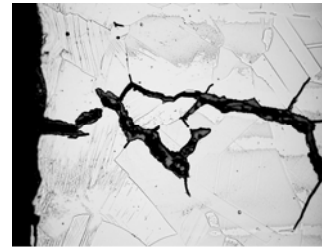Figure 2. Evidence attached from website.

0. 5mm

Figure 2. Evidence attached from website.

    We should only believe what we could see (measure)!
    We could not believe what we haven't seen (measured)!

Professor Yi-Heng Chen