Thermal resistance measurements between a glass bead and a plane from large distance to contact

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Thermal insulation materials such as glass wool are characterized in industrial laboratories at macroscopic scale but the urge to perform energy savings pushes industrials and researchers to gain knowledge about the heat transfer at the microscopic scale. In such materials the heat flow is guided through a complex network of fibers and contacts. There is a need for a better understanding of the resistance of contact between two fibers.

The physic of contact is complex. It involves solid-solid transfer and solid-liquid transfer through the water meniscus[1]. Some measurements of the resistance of contact between an heated silica bead on a SThM tip and a substrate have already been reported. They were made under vacuum conditions, where the solid-liquid interaction is negligible[2,3]. But it does not represent the *in situ* ambient conditions which are encountered in thermal insulation materials.

In this paper, we propose a SThM based method to measure the resistance of contact between a 20 μm glass bead and a glass surface under ambient conditions. This bead/surface situation is a first step to the fiber/fiber contact. First, a SThM tip is glued to a bead. Then the bead is heated by Joule Effect at a well-known distance from the surface. The latter is progressively reduced in a controlled manner thanks to the SThM, until the bead enters in contact with the glass surface while the temperature on top of the bead is monitored. In this situation, every heat paths are easily identifiable as an equivalent circuit of thermal resistors. An analytical approach combined with simulations is proposed to model the experimental temperature curve and to model and estimate the thermal resistance of contact.

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