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Capillary force model to express bonding between two velcro-like surfaces at ambient environment

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Further miniaturization of micro systems devices towards "smart dust" requires new bonding technique with self-alignment capability to alter the traditional pick and place methods. Additionally, there is a need for low temperature bonding techniques in packaging of even traditional smart systems. Porous silicon based bonding permits strong permanent bonds between Velcro-like (needle-like) surfaces as well as multiple bonding and un-bonding of the same chips similar to Velcro- principle. The bonding between two Velcro-like surfaces at ambient environment can be modelled based on capillary condensation approach. Under this hypothesis, the effect of each needle is considered individually and the total bonding force is obtained by summing up the contributed needles. A conical shape needle is represented as a cylindrical needle with hemisphere head, and the total interaction is divided into two parts: i) interaction between hemisphere head and substrate ii) interaction between neighbored or interlaced needles.

The Velcro-like surfaces are simply created by anodizing the surfaces of low doped p-Si wafers in HF/water solution. The bonding of the surfaces are carried out by pressing two of such surfaces together by applying weight loads at room temperature. Different bonding forces are obtained through bonding of two similar surfaces with an area of 0.409 cm^2 when pressed with different loads. The required surface parameters are measured and fed into the model. The measurements and simulations results fits together by considering losing 10-20% of needles during bonding process.

Biography

Shervin Keshavarzi has completed his MSc in Microsystems Engineering from Furtwangen University and has been recently doing his PhD in the Department of Microsystems Engineering (IMTEK) of Freiburg University. Since 2012, he is working as Assistant Researcher in the Institute of Applied Research (IAF) in the Furtwangen University.

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