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Flexible and Stretchable Electronics

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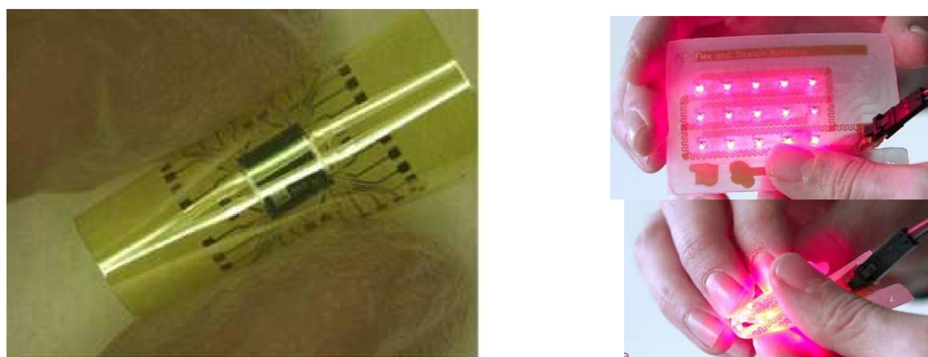
Conventionally electronics circuits are produced by assembly of packaged components on flat, rigid printed circuit boards. However there is a growing demand for 2.5 dimensional (2.5D free form surfaces) or even full 3D electronics. Applications for such circuits are found in a vast range of fields: such circuits are desirable for comfort and ergonomic reasons (e.g. in wearable or implantable circuits), to respond to design and aesthetics considerations (e.g. 2.5D or 3D light sources), for ecological reasons (more efficient materials usage, less CO_2 emissions in automotive applications) etc. In this contribution we will present two technologies, under development at our laboratory, which open the way to industrial production of randomly deformable circuits. These technologies are :

- The ultra-thin chip package (UTCP) technology, by which bare Si (or other anorganic semiconductor based) chips are thinned down to a thickness of 20-30µm, embedded in a stack of spin-on polyimide layers, and provided with a fan-out metallization, resulting in an extremely miniaturized, lightweight and flexible chip package with a total thickness below 100µm
- A number of technologies for dynamically stretchable (i.e. elastic) circuits, which are based on the interconnection of individual components or component islands with meander shaped thin-film or Printed Circuit Board (PCB) based metal wirings and embedding in elastic polymers like PDMS (silicone rubbers) or PU (polyurethanes)

Process flow details, reliability data and applications for these technologies will be presented.



Left : Ultra-thin chip package;
right : 15-LED stretchable circuit, before (top) and during (bottom) extreme deformation