Nanoimprint lithography for the fabrication of surface acoustic wave devices.

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Abstract

DTI is developing state-of-the-art lithography processes for the production of novel surface acoustic wave devices (SAW) which are to be used in wireless sensing in harsh environments.

DTI has identified nanoimprint lithography (NIL) as an emerging next generation lithographic technology which has the great benefit of ultra high resolution combined with low cost of ownership, enabling cost-effective nanostructuring for DTI clients. Our objectives is to employ *jet and flash* NIL (J-FIL) for production of high end SAW sensor systems to be used in various sensor applications, i.e. ultra high temperature sensing, or gas sensing. The J-FIL technology is based on the principle that a pre-designed fused silica template (mold) is pressed down into a monomer resin which has been *dispensed on demand* on a substrate. During the imprint process the polymer is cured by UV-light. After that the template has been detached further micro processing is possible using the polymer film as deposition/etch mask. The J-FIL technology is ideally suited for high resolution lithography on fragile substrates due to the extremely low contact forces present during the imprint process in comparison to other NIL technologies present. The technology can be used for structuring features down to 50 nm and below. At present SAW devices have been fabricated on various materials such as Lithium Niobate, Quartz, and Langasite. Examples of SAW responses are presented in fig.1. The future objective will be to demonstrate pilot production of ultra high frequency SAW devices in collaboration with or strategic SAW partners. Investigations will focus on SAW frequency limits, group velocity, and propagation losses. At present DTI is capable of producing some 1000 SAW devices per hour using NIL. However, the process is directly transferable to full volume production of some 1000 devices per minute using large volume NIL tools provided by Molecular Imprints Inc.

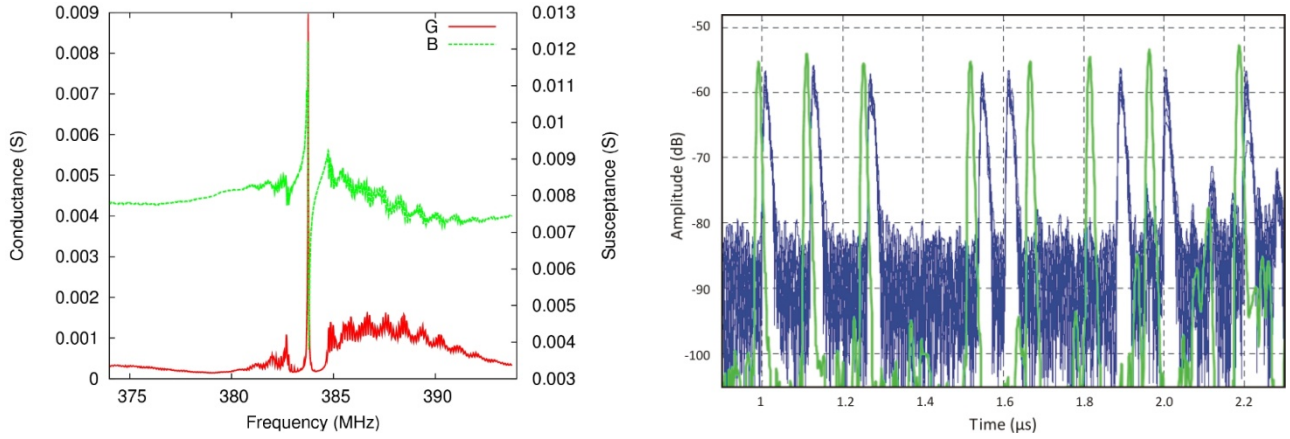

Figure 1. (left) A Hicup resonator device, produced on Langasite using J-FIL, with a clear resonance in the middle of the stop band (Q factor in excess of 12 000). (right) Comparison between 2.45 GHz delay line SAW devices fabricated by conventional fabrication technologies (green curve) and J-FIL (blue curve).