

# Piezoelectric ceramics deposition on quartz

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The Swiss quartz crystal manufacturer Micro Crystal AG is perpetually reducing the size of its products. Of course, this results in big challenges on adapting critical production processes, particularly in the photolithographic section. New methods and concepts are in demand. One of them involves the coating of a piezoelectric ceramic thin film on quartz substrates. As this has never been done before, the feasibility must be proven.

## Background

Since years, the miniaturisation of components is a well-known trend in the micro electronics sector. This progress led to the impressing potential of present-day electronic gadgets, such as tablet PC's or smart-phones. At Micro Crystal, one can understand the extent of this trend by looking at the development of a standard crystal resonator's package size: In the past 25 years, its volume got decreased by 97%. Nowadays, the required accuracy on photolithographic process steps is very high, making them highly critical and expensive due to narrow process latitudes. To dodge some of these critical processes, Micro Crystal's development depart-

ment has designed a new resonator concept. It involves the coating of a piezoelectric ceramic thin film on the quartz substrates.

## Results

As a first step, the required theoretical foundations related to the project were investigated. Detailed information on quartz crystal properties and their manufacturing processes was collected. Possible piezoelectric ceramic thin film deposition methods were compared. As it is offering crucial advantages like homogeneity and high production throughput, pulsed laser deposition became the method of choice.

In order to define the required thickness of the piezoelectric thin

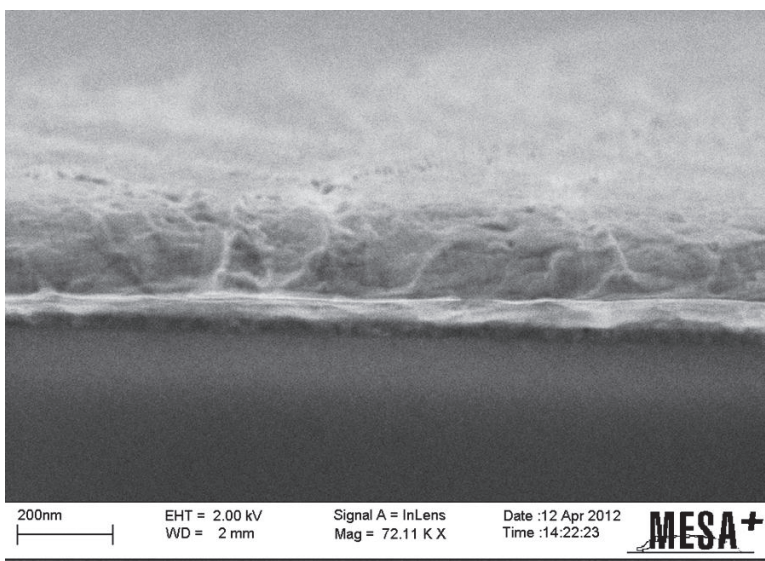
film, elaborate FEM simulations were performed. They provided promising results by approving the resonator concept to be functional. Thereby the knowledge was sufficient to perform practical deposition tests. For that purpose, contacts with a company specialised on pulsed laser deposition were made.

A face to face meeting was held at the Micro Crystal headquarters. The most important specifications were exchanged and a detailed experiments set-up was written down. Substrates were prepared at Micro Crystal and shipped. After the first deposition runs, an external partner offered a detailed analysis of the quality, homogeneity and performance of the thin films. The first coatings were successful, as there were no major difficulties such as insufficient adhesion or high residual strain and stress in-between substrate and thin film.



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Piezo ceramics thin film on quartz substrate