Deep micromachining of insulating materials by etching of laterally constrained distributions of ion tracks

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Deep and vertical microstructuring by wet etching of swift heavy ion induced damages (ion tracks) is here performed in materials possessing a less attractive anisotropy or lacking crystallinity, such as single crystalline quartz, mica, glass and polycarbonate. The concept is named micromachining by ion track etching, MITE. Quartz resonator structures are made by uniform irradiation with ions and etching in lithographically defined areas. The latent, i.e., unetched, damage in the remaining structure is shown to be of little significance for the Q-value and thermal behaviour of such resonators. A new scheme, projection MITE, resting on direct patterning by a shaped ion beam to eliminate also this influence is demonstrated. The definition of edges and corners vs. the ion fluence is investigated. The projection MITE allows miniature structures to be etched out of substrates without the need of a deposited and patterned masking material, which is also shown. Furthermore, a first attempt to demonstrate negative and density-projection techniques based on this kind of MITE is made.