BENZOCYCLOBUTENE AS A DIELECTRIC SPACER FOR FIELD EMISSION ELECTRON SOURCES

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ABSTRACT

Silicon based field emitters are promising candidates for the application in electron sources, vacuum sensors and X-ray tubes. As presented in [1] it is possible to fabricate black silicon structures on high pillars for field emission arrays by reactive ion etching (RIE). Typically, such electron sources consist of a cathode, a dielectric spacer and an extraction grid [2]. Instead of using a mica spacer (50 µm) between the cathode and anode, benzocyclobutene (BCB) can be directly integrated. For this the wafer is covered with BCB and in a next step the BCB is etched back in the region of the emitter array to uncover the pillars. The final structure is depicted in Fig. 1. It allows the realization of an assembly consisting of only two components (cathode with BCB and grid). BCB polymers have a low dielectric constant which makes them a good dielectric material. The layer thickness can be adjusted by the spin-coating rotation speed. BCB has a high degree of planarization. The degree of hardness depends on the temperature and duration of curing. After curing it can be patterned with RIE using oxygen and a fluorine-containing gas.
The FE properties of the electron source are investigated by measurements under ultrahigh vacuum conditions at a pressure of 10^{-9} mbar. For a BCB thickness of 5 µm a voltage of 400V can be applied to the system with low leakage currents of a few pA. With a reduced distance between anode and cathode higher field emission (FE) currents at lower operational voltages are possible (Fig. 2). A comprehensive overview on the measurement results will be presented at the conference.

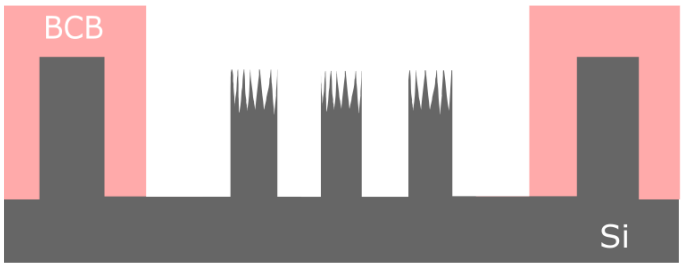

Figure 1. Silicon field emitters with a BCB layer as a spacer for the extraction grid

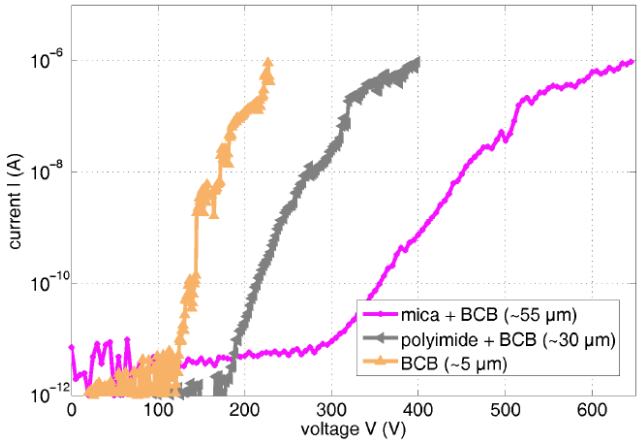

Figure 2. Influence of the spacer thickness on the I-V-characteristics [3]

References

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