PRESSURE INSENSITIVE TRANSFERRED GRAPHENE-OXIDE-SEMICONDUCTOR ELECTRON FIELD EMITTER

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ABSTRACT

Field emission is often realized by arrays of sharp tips with high aspect ratios in order to obtain the necessary electric fields while keeping the applied voltage in a controllable manner. However, especially small apex radii are highly sensitive to poor vacuum conditions and therefore not applicable at higher gas pressures. In recent years a growing interest in planar electron field emitters based on graphene-oxide-semiconductor (GOS) structures was established, since the emission properties are pressure independent due to the buried tunnel barrier.[1] The main challenge of these field emitters is their efficiency, which is calculated by the ratio between the emission current and the total current through the tunnel oxide. It is mainly influenced by scattering processes in the oxide and graphene during transmission.[2] By decreasing the thickness of the graphene electrode less scattering and therefore higher efficiencies can be reached.[1] In this contribution we present a highly efficient GOS electron field emitter with a transferred monolayer of graphene as the emission electrode.

The emitter consists of rectangular windows patterned into a 300 nm thick wet oxide, wherein a 10 to 22 nm thick dry tunnel oxide is grown. With a wet transfer technique, based on PMMA, catalytically grown graphene is placed on top of the tunnel oxide. To match the oxide windows the graphene is subsequently structured in an oxygen plasma. Finally, aluminium contact electrodes are evaporated and patterned by lift-off process.

During electrical characterization the voltage between the substrate and the graphene electrode is varied up to 30 V in a poor vacuum environment of about 10-3 mbar. The tunnel current as well as the emission current of the GOS are measured. The determined efficiencies show values up to 23% which surpasses the efficiency of former GOS with transferred graphene nearly by a factor of 2.[3] Samples with different oxide thicknesses will be presented and compared to literature. Furthermore, measurements at ambient pressure levels will be shown.

References

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