S10-O2

Near field investigation of GaN surface relief grating coupled plasmon phonon polaritons

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Semiconductor based thermal radiation sources based on hybrid Surface Plasmon-Phonon Polariton (SPPhP) excitation in n-GaN gratings were recently developed demonstrating emission of high spatial quality in a far-field with high coherence in the vicinity of transfer optical (TO) phonons frequency, namely at wavelengths near 570 cm^{-1}[1]. While far-field results show promising macro-scopic behavior of the SPPhPs, an understanding of underlying physics and extended applicability of the emitters can be obtained by performing near-field studies of the SPPhP characteristics. Initial studies with clasical Scanning Near-field Optical Microscopy (SNOM) geometry of top-side far field illumination at a certain excitation beam incidence angle have shown the technique limitations observing the propagation distance values of up to 30 µm only.[2] In this work we implemented a novel SPPhP excitation scheme, where back-side laser excitation beam is used to excite SPPhPs in the center of a circular n-GaN surface relief grating through a laser-milled via with diameter of around 25 µm . The electric field of the propagating SPPhPs was then recorded using pseudo-heterodyne SNOM scheme with decoupled excitation – probe regime. The grating topography map and SNOM signal phase results are shown in Figure 1, obtained in a wide measurement window reaching size of up to 250 µm. Moreover we observed SPPhP propagation in distances over 250 µm by SNOM measurements of evanecent electic field components and direct comparison with the numerical FDTD modelling results. Modelling also revealed possibility of longer propagating polaritons achievable by optimazation of the gratingf illing factor.

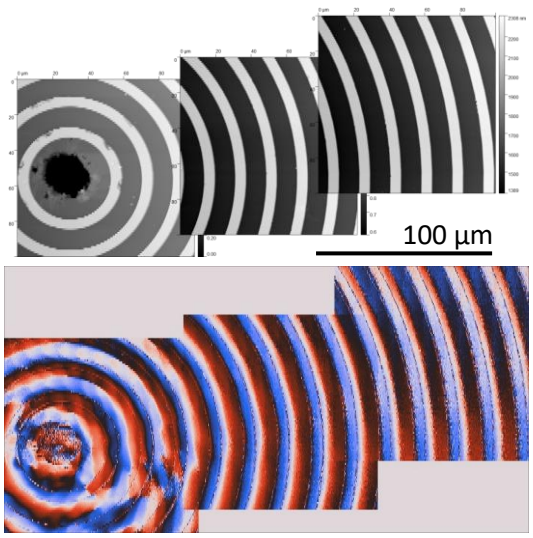

Fig. 1 Measured sample topography (Top) and Phase (Bottom) of the investigated surface relief grating at the laser excitation frequency of 570cm^{-1}.

REFERENCES

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