

# All optical Spatial Self Phase and Cross Phase Modulation using Nb<sub>2</sub>CT<sub>x</sub> MXene Nanosheets

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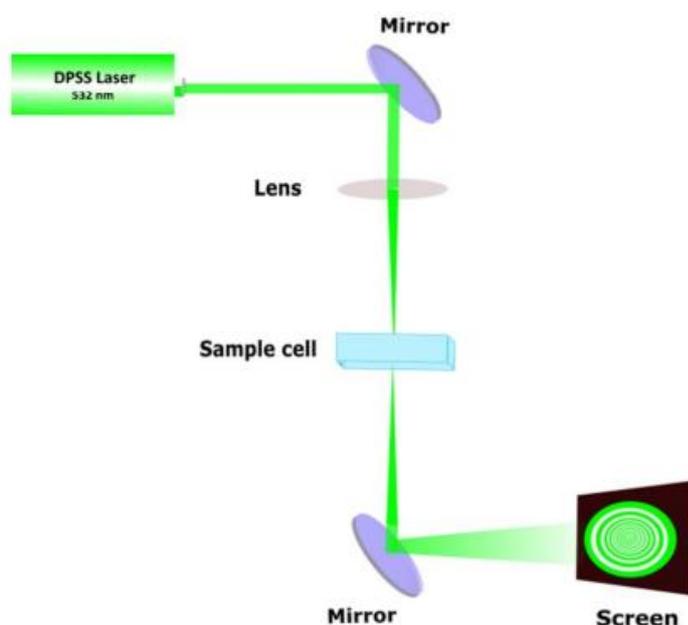
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All-optical Spatial Self Phase Modulation (SSPM) and Spatial Cross Phase Modulation (SXPM) in Nb<sub>2</sub>CT<sub>x</sub> MXene nanosheets are demonstrated as an efficient platform for third-order nonlinear photonic applications [1]. Few-layer Nb<sub>2</sub>CT<sub>x</sub> nanosheets exhibit strong nonlinearity originating from their metallic conductivity and tunable surface terminations (-O, -OH, -F), enabling pronounced intensity-dependent refractive index modulation. Nb<sub>2</sub>CT<sub>x</sub> MXene nanosheets were obtained from the selective etching of Al from Nb<sub>2</sub>AlC MAX phase [2], followed by the DMSO intercalation. When an intense light beam is absorbed by a medium, the phase of the beam undergoes a modulation, which in turn produces an interference pattern. Under laser excitation (532 nm DPSS laser), distinct concentric diffraction rings confirm SSPM behaviour, from which the nonlinear refractive index, thermo-optic coefficient and susceptibility are calculated [3]. Concentration dependence and incident intensity dependence of diffraction annuli rings were also studied. Spatial cross-phase modulation is further realized using co-propagating pump and probe beams, where the pump-induced refractive index gradient effectively controls the spatial phase and beam profile of the probe, paving the way to optical switching applications [4].

## References

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- [2] Jiang Y, Tian M, Wang H, Wei C, Sun Z, Rummeli MH, Strasser P, Sun J, Yang R, *ACS nano*, 12(2021)19640-50.
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## Figures



**Figure 1:** Experimental setup of Spatial Self Phase Modulation using Nb<sub>2</sub>CT<sub>x</sub> MXene nanosheets