

# **Metamaterials for Multi-functional and Ultra-Sensitive Mid-Infrared Spectroscopy**

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Identification and characterization of bio-chemicals is essential for biomedical research, homeland security and environmental monitoring. For example, characterizing proteins and their interactions could be important in early diagnosis and treatment of diseases. In principal, mid-infrared absorption spectroscopy can provide a wealth of chemical information about biological samples. However, existing mid-IR spectro-microscopy methods suffer from several fundamental problems including low sensitivity, low spatial resolution, bulk measurements, strong water absorption. We will demonstrate that plasmonic metamaterials can be used to overcome these fundamental challenges, and enable ultra-sensitive and multi-functional spectroscopy tools for biology.

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