Fungi have pervasive and essential roles in plant survival that include symbiotic relationships wherein fungi trade services for food. While some species are plant pathogens that destroy crops and threaten food supplies, others participate in symbiotic relationships with plants, helping them acquire nutrients from soils. A better understanding of fungal growth, cell composition and how they interact with the environment is necessary to control their activities.

Fungi grow by extending long, tubular hyphae; growth occurs only at hyphal tips. During growth, hyphae exude enzymes as a method of nutrient acquisition. Synchrotron Fourier transform infrared (sFTIR) spectromicroscopy is well suited to the analysis of fungal hyphae. We are using several complementary tools to examine fungi compositions and the effect of biochemical differences that exist between different isolates of the same species. Instruments used include: Synchrotron FTIR mapping (Single pixel raster scan, Continuum, 0031 beamline SRC), Synchrotron FTIR imaging (IRENI, SRC), Thermal source FTIR imaging (Varian 670/620, U of Manitoba), and Raman mapping (Renishaw, U of M Manitoba). The IRENI beamline at the Synchrotron Radiation Center provides 0.54 µm pixel resolution FTIR images which offer greater detail about cell composition. In some C. protuberata hypha, we have discovered the spectral signature of crystalline mannitol, a fungal polyol involved in providing stress tolerance to fungi. Mannitol’s presence may be more common in geothermal rather than non-geothermal isolates. This is the first time that mannitol has been directly observed in fungal hyphae.

Metal nanoparticles are of great interest both fundamentally and technologically due to their unique chemical and physical properties compared to their bulk counterparts. Some fungi have displayed the capability to reduce metals and form various kinds of intracellular and extracellular metal nanoparticles enzymatically. We have synthesized gold nanoparticles (AuNPs) in different shapes, sizes, and compositions using filamentous fungus (*Aspergillus nidulans*). Critical parameters such as temperature, pH, exposure time to metal, biomass and metal concentration affect the growth conditions (size and shape), cellular activities, and enzymatic processes. TEM images of cells after incubation with chloroaurate ion solution vividly show the formation of gold nanoparticles. Assembly of metal particles on fungal mycelia could be an effective tool for biochemical analysis with Surface-enhanced Raman scattering (SERS) in conjunction with IR imaging. More pictures and related data will be shown in poster.

**References**
