Our research activity aims to deepen the understanding of the systematical synthesis of metal nanoparticles possessing tunable absorption bands, to examine their photothermal heating properties, and to utilize them in various optically active systems upon irradiation of a solar-simulated light. Conventional spherical metal nanoparticles possess a strong but narrow absorption peak in the visible range, but anisotropic/modified metal nanoparticles can have strong and wide absorption bands across the visible to near-infrared region. In addition, these metal nanoparticles have a unique ability to absorb light energy and convert it into heat (i.e., the photothermal heating process). As such our recent research focuses on the investigation of photothermal heating properties of various metal nanoparticles and their potential applications in the area of optically driven catalytic reactions, signal enhancing spectroscopy, and drug-delivery triggering components under solar irradiation. Considering recent environmental concerns and the soaring demand for renewable energy, this study is especially relevant. A thorough investigation of the structure-dependent absorption properties, photothermal heating efficiency, and other activities of various nano-scale metal particles under solar light ultimately allows for the development of cost-efficient and practical optical materials.