# Non-Linear Optical response of materials

*Rimsha Amjad*[1], *Yu-Chieh Wen*[2]

[1]Department of Physics, National Central University, Taiwan
[2]Institute of Physics, Academia Sinica, Taiwan

e-mail: amjad0001@as.edu.tw

## ABSTRACT

My academic and research background lies in materials science, with a focus on the 3D printing of polymer-ceramic composite scaffolds for biomedical applications. During my Master's research, I developed and optimized poly (vinyl alcohol) (PVA)-Wollastonite ($CaSiO_3$) composite hydrogels for tissue engineering. This work addressed key challenges in replicating the mechanical and bioactive properties of native cartilage while improving structural integrity, swelling behavior and biocompatibility [1].

My current research motivation is to explore the optical behavior of advanced materials through nonlinear optics. Nonlinear optical phenomena such as harmonic generation, optical mixing, and refractive index modulation offer powerful approaches to probe material properties at the micro and nanoscale. The intersection of materials science and optical physics presents an exciting opportunity to link structural and functional understanding by investigating how microstructural parameters like grain size, porosity, and interfacial composition influence light-matter interactions [2].

Laser-based optical techniques play a central role in this pursuit, enabling precise and non-destructive material analysis. My goal is to integrate nonlinear optical methods to study multifunctional materials for photonic and optoelectronic applications. Initially, I am learning how to align the laser beam and studying the alignment of different optical components. After gaining sufficient practical understanding, I will proceed to select suitable materials for investigating various optical phenomena. With access to a femtosecond laser system, I aim to perform nonlinear optical characterization of quantum materials focusing on second and third harmonic generation (SHG, THG) and ultrafast carrier dynamics. Establishing SHG setup will allow determination of nonlinear susceptibilities ($\chi^2$, $\chi^3$), providing insight into the nonlinear optical response of emerging materials.

## REFERENCES

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2. Liu, G. *et al.* in Fundamentals and Applications of Nonlinear Nanophotonics (ed Nicolae C. Panoiu) 393-440 (*Elsevier*, 2024).