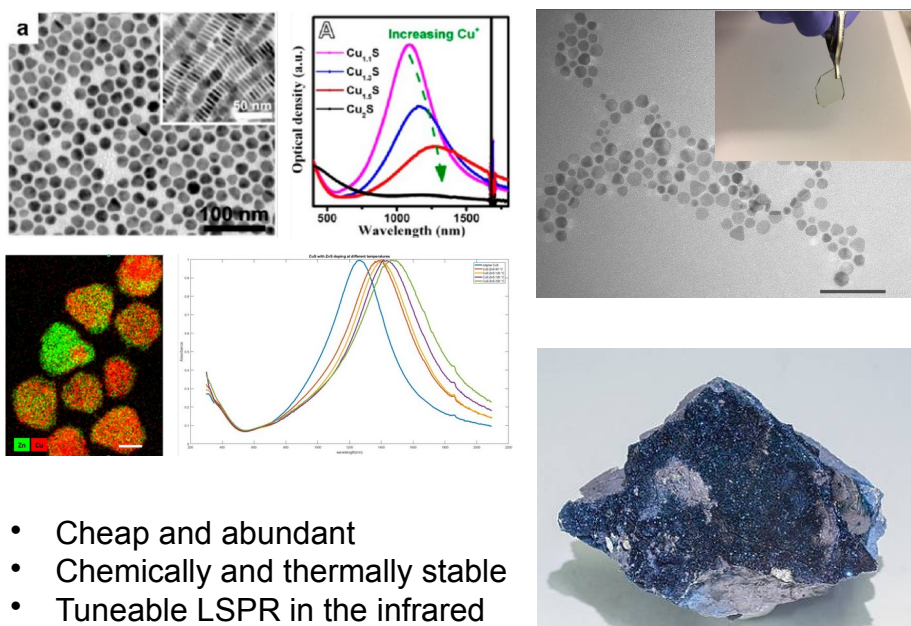


# Ultrafast nonlinearity in a novel plasmonic material: nanostructured copper sulfide

Anton Yu. Bykov, Amaresh Shukla, Mark val Schilfgaarde, Mark A. Green, Anatoly V. Zayats

Department of Physics and London Centre for Nanotechnology, King's College London, London, UK

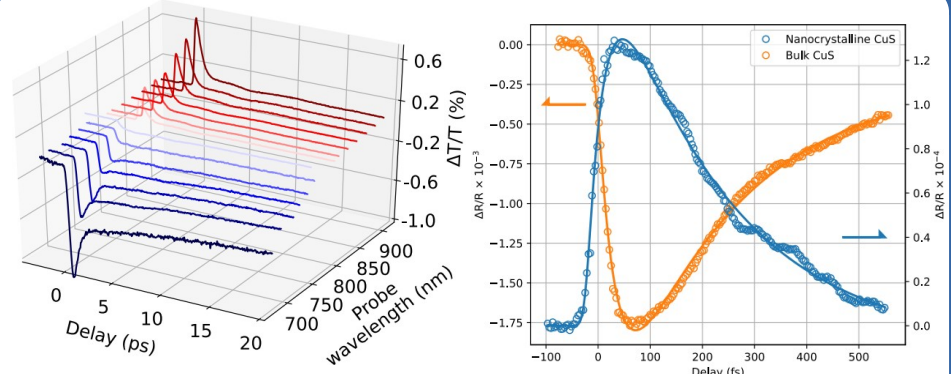
## Copper sulfide



- Cheap and abundant
- Chemically and thermally stable
- Tuneable LSPR in the infrared

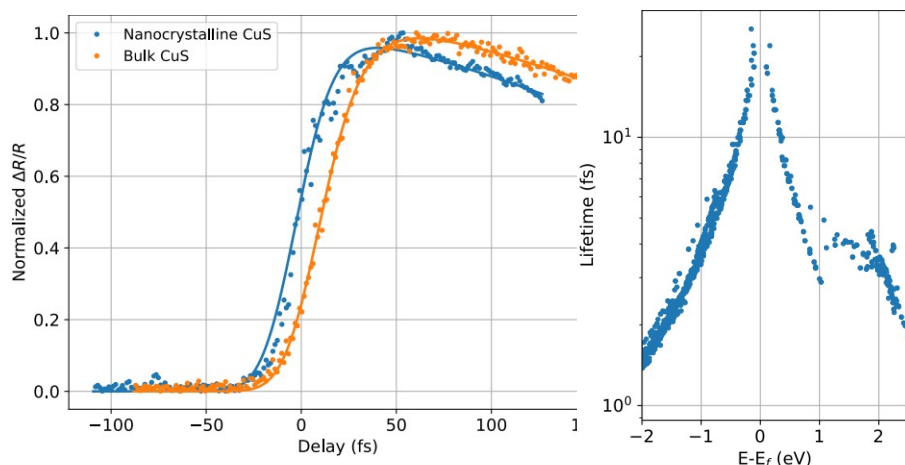
Ya. Liu, et al., J. of Phys. Chem. C **121**, 1435 (2017)  
Ya. Liu, et al., Appl. Mater. & Interfaces **10**, 42417 (2018)

## Ultrafast hot electron dynamics



Attribute	CuS	Silver	Gold	Graphene
Rise time	20 fs	350 fs	500 fs	10-50 fs
Decay time	150 fs	1-5 ps	1-5 ps	150 fs

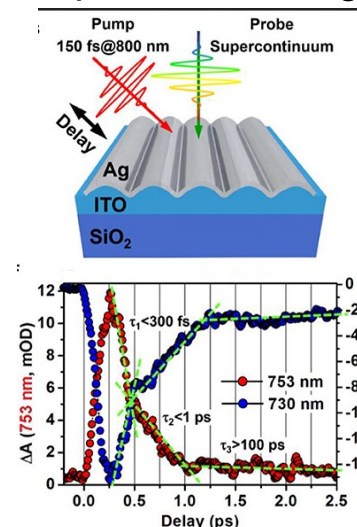
## Nonequilibrium relaxation in nanoparticles



Attribute	CuS Nanoparticles	Silver nanoparticles (4 nm)	Gold nanoparticles (2 nm)
Nonequilibrium relaxation	14 fs	160 fs	120 fs

## Applications

- Optical switching, polarization control, etc.



Commercial solution	Switching speed
Electrooptic/Acoustooptic	~ ns
MEMS	100 ms
Liquid Crystals	10 μs
Thermal switching	100 ms

X. Zhang, J. Yang, Frontiers in Physics, **7**, 190 (2019)

- Sensing