

# Abstract

Metamaterials have effective properties that are distinctive from their composites as they consist of engineered designed properties that are not in nature. In order to be able to design a metamaterial, we should establish sufficient understanding of the properties of the constituents. This will enable us to engineer new effective parameters of the metamaterial. We shall perform a detailed analytical study for the effective parameters and the constituents' parameters of silver-silica metamaterial. This will define the optical response of the mixture at different sizes of the inclusions' and different volume fractions of the silver and silica. Also an optimum value of the volume fraction value is proposed to achieve a broadened resonance optical response. Finally, we propose the design technique and constraints of a non- magnetic optical cloaking device, based on high order transformation optics with different volume fractions of silver and silica. The work is done on analytical grounds but also available numerical tools are fully exploited for this analysis.

## **Covered subjects**

- Understanding and learning numerical and analytical techniques to describe metamaterials
- Homogenization of metamaterials and their effective description using various concepts
- Modeling and simulating TM cylindrical invisibility cloak using MM
- Discussing spectral properties of metamaterials at different frequencies (visible range) and understanding the peculiarities