# Multiple scattering of a focused laser beam by a cluster consisting of nonconcentric encapsulated particles

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## Abstract:

The optical characteristics of a cluster consisting of zinc sulfide (ZnS) particles doped with a nonconcentric spherical copper (Cu) cores illuminated with an arbitrarily focused Gaussian beam are investigated. The presented aggregations of nonconcentric doped particles (i.e. core with offset origin) form linear chains or densely packed clusters. The laser beam is modeled using angular spectrum of plane waves method and then combined with the cluster T-matrix method which is modified to solve such difficult multiple scattering problem. This combination provides a powerful mathematical technique to obtain the phase (scattering) matrix of a cluster illuminated with any incident electromagnetic fields. The scattering matrix provides complete descriptions of the scattering characteristics in the far field zone. The computed results are shown for different beam waists with respect to the cluster. The scattering processes and its results help understanding many cluster characteristics and nonlinear processes. The presented numerical results show that the elements of the scattering matrix are sensitive to the focusing of the incident beam and characteristics of the cluster constituents. The illustrated results are important for researches aim to improve polymer properties and to study several branches of practical sciences and industries such as nanotechnology, pharmaceuticals, chemistry, and biology. This paper represents the first attempt to study the multiple scattering from a cluster of nonspherical particles with nonconcentric spherical cores illuminated by an arbitrarily focused laser beam.

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