Using linear and nonlinear optical scattering to measure stuff

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Solid-state and optically turbid materials are commonly employed in the production of materials for heavy industry (think cement), food (e.g., yogurt), and drugs (e.g., tablets). It has proven challenging to effectively monitor and provide in-line process control for these manufacturing steps because commonly employed monitoring techniques are too sensitive. For instance, a drug formulation will go through many manufacturing steps before the final product is produced and during that time the particle size, formulation density, crystalline form, and chemical concentrations will all change continuously. Optical monitoring techniques can and do detect all of these changes, and therein lies the problem: the changes in the optical properties of the sample cannot be linked to a unique change in the formulation. The result is that optical techniques perform spectacularly in the laboratory and very poorly in the factory.

We are using nonlinear optics in combination with autocorrelation techniques to separate the spectral changes due to the physical properties of the sample (e.g., particle size and scattering density) from those due to within particle changes (e.g., chemical composition, or crystalline form). This presentation will cover some theory and recently obtained results.