Research Topic : **Acoustic Monitoring and Characterization of Drug Tablets**
Duration : **2005-Present**
Sponsor(s) : **Wyeth, Consortium for Adv. of Manufacturing in Pharmaceuticals**
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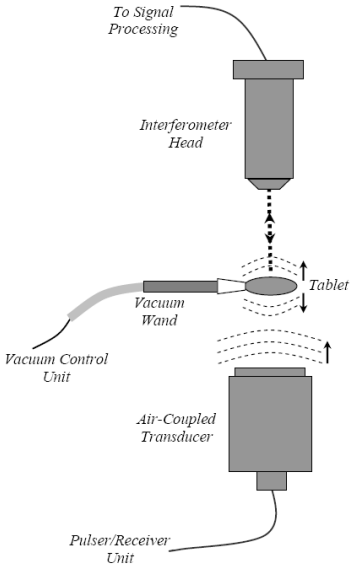
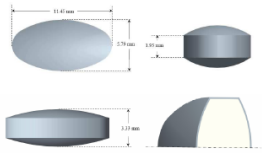
Synopsis of Research and Sponsored Projects

Physical properties and mechanical integrity of drug tablets as well as their coat thickness and quality can affect their critical therapeutic and structural functions. Monitoring for defects and the characterization of tablet mechanical properties are of great practical interest in drug tablet manufacturing and unit operations. The objective of this project is to develop non-invasive, non-destructive acoustic techniques for pharmaceutical manufacturing applications as well as to understand fundamental factors affecting mechanical properties of tablets.

In *the Photo-Acoustics Research Laboratory*, we utilize acoustics wave propagation for monitoring





applications as diverse as mechanical property determination of drug tablets, thickness measurements of tablets with different coating levels and surface crack detections in coated tablets in a non-contact, non-destructive manner.

In practice, the mechanical properties of drug tablets are typically measured by destructive tests. These tests not only can damage the microstructure of the tablet, but also provide limited information about the actual mechanical properties of its core and coating layers. Therefore, development of efficient non-destructive, non-contact techniques for measuring and evaluating the mechanical properties of drug tablets, crack detection in coated tablets and thickness measurements with various coating levels are of interest in the pharmaceuticals industry. Moreover, monitoring unit operations and processes are further recommended by the *Process Analytical Technology* (PAT) initiative, which was launched by the *U.S. Food and Drug Administration* (FDA).

In this project, acoustic field generated by the air-coupled transducer in the sub-megaHertz range is used to excite a number of vibrational modes of the tablet. The tablet surface vibrational responses at a number of points are acquired by a laser interferometer in a non-contact manner. Both analytical and computational techniques are employed in our investigations. The effectiveness of the developed procedures for determining the mechanical properties of tablets and the thickness of a coating layer of tablets from a set of experimentally obtained resonance frequencies has been demonstrated. It is reported that computationally extracted mechanical properties and tablet coating thicknesses are in good agreement with those destructively measured. Also, based on a similar approach, a non-destructive and non-contact technique is developed to discern defective tablets from non-defective ones.

Since acoustic waves are mechanical and can penetrate deep into the structure of a tablet, acoustic techniques utilized in *the Photo-Acoustics Research Laboratory* can have clear advantages over many indirect techniques discussed in the literature in testing and evaluating the mechanical integrity of drug tablets.

Recent Publications

1. I. Akseli, C. Cetinkaya, *Drug Tablet Thickness Estimations using Air-coupled Acoustics*, Accepted for publication, Int. J. of Pharmaceutics, 2007.
2. I. Varghese, C. Cetinkaya, *Non-contact Photo-acoustic Defect Detection in Drug Tablets*, J. Pharm. Sci., 96, 2007.