Contribution ID: **243** Type: **Oral Presentation**

Enhancement of in-situ terahertz liquid front tracking technique in porous media using a novel experimental setup and associated analysis tool

Monday, 30 May 2022 10:50 (15 minutes)

Terahertz pulsed imaging (TPI) technology can be used to track a liquid front in-situ during the imbibition of porous media such as pharmaceutical tablets and ceramic catalyst supports [1,2]. The method can resolve relatively fast transport phenomena with a time resolution of less than 100 ms. It can also be used as a non-contact and non-invasive quality inspection method to estimate the porosities of dry samples [3] with potential applications, in particular, in the pharmaceutical industry.

One of the applications of interest is the investigation of the correlation between the liquid uptake kinetics in pharmaceutical solid dosage forms and the resultant disintegration process. In the previously used experimental setups, the imbibition process commenced by bringing water in contact with the bottom surface of the sample using a flow cell. Given the design of the flow cell the deaggregated agglomerates largely remained within a certain boundary from the tablet matrix and liquid ingress was restricted to the bottom surface and not from the sides, which may affect the kinetics of the liquid uptake compared to the typical disintegration process in dissolution medium where aggregates can freely erode in all directions during liquid ingress into the tablet matrix.

In this study, we present a novel experimental setup for in-situ terahertz liquid tracking in pharmaceutical tablets. This setup adopts a bespoke sample holder that exposes over half of the tablet surface to the liquid medium. The new method exposes the tablet samples to its sides as well as its bottom face so that radial as well as axial liquid transport can take place thus removing some of the constraints in the experimental boundary conditions. We also introduce a novel terahertz signal analysis tool that compares terahertz time-domain signals each other after applying a digital signal filter to identify and extract the subtle traces of the water front in the tablet which allows us for the first time, without the need for any hardware modifications, to investigate liquid transport in tablets up to 5.5 mm thick, compared to measurements that were previously limited to roughly half the thickness.

The observations of this study for complex formulations of drug products suggest two-phase kinetics with a linear function for the predominant phase whereas prior research on less complex formulations was able to rationalise the liquid transport using a single power-law function based on the concept of Darcy flow in porous media. The aim of our future research will be to explore the complexity of typical pharmaceutical tablet formulations on the liquid transport and particle swelling processes that result in the disintegration of the dosage form and to model the process based on physical understanding in order to develop predictive capabilities to aid rational dosage form and process design.

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

United Kingdom

References

[1] Yassin, S. et al. The Disintegration Process in Microcrystalline Cellulose Based Tablets, Part 1: Influence of Temperature, Porosity and Superdisintegrants. J Pharm Sci 104, 3440–3450 (2015).
[2] Al-Sharabi, M. et al. Terahertz pulsed imaging as a new method for investigating the liquid transport kinetics of α-alumina powder compacts. Chem Eng Res Des 165, 386–397 (2021).
[3] Bawuah, P. et al. A Fast and Non-destructive Terahertz Dissolution Assay for Immediate Release Tablets. J Pharm Sci 110, 2083–2092 (2021).

Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

In person

Primary author: LEE, Jongmin (University of Cambridge)

Co-authors: GOODWIN, Daniel J. (GlaxoSmithKline); DHENGE, Ranjit M. (GlaxoSmithKline); BANO, Gabriele (GlaxoSmithKline); ZEITLER, Axel (University of Cambridge)

Presenter: LEE, Jongmin (University of Cambridge)

Session Classification: MS10

Track Classification: (MS10) Advances in imaging porous media: techniques, software and case studies