（様式５）

2023 年　6 月　16 日
Year Month Day

学位（博士）論文要旨
(Doctoral thesis abstract)

論文提出者 Ph. D. Candidate	生物システム応用科学府　食料エネルギーシステム科学　専攻　一貫制博士課程 平成　３０年　度入学(Your Entrance Fiscal Year) 氏名 Tiara Nur Pratiwi (Your Name(Family, First) and Seal)				
主指導教員 氏名 Chief Advisor's Name	Wuled Lenggoro	副指導教員 氏名 Vice Advisor's Name	Kazuya Nakata	副指導教員 氏名 Vice Advisor's Name	
論文題目 Title	Heat and Flow Phenomena in Liquid Filled Thin Porous Materials: Design and Visualization Techniques [液体充填多孔質材料における熱移動と液体流動：合成及び可視化技術の開発]				

論文要旨（和文要旨(2000 字程度)または英文要旨(500words)）
※欧文・和文どちらでもよい。但し、和文の場合は英訳を付すこと。
Write a summary in Japanese (2000 characters) or in English (500words).
If the abstract is written in Japanese, needed to translate into English.

A study on the design and interaction between thin porous materials and liquid under heating is important for developing robust thin porous media for applications in separation, catalysis, energy storage, and sensing. Nanometer- to micrometer-sized particles are often added to functionalized thin porous materials. However, most of the presently available design strategy has not properly addressed the issue of the non-uniformity of particle distribution in the matrix of porous materials and the strength of particle-to-matrix interaction, which may risk particle leaching from the matrix during application. Additionally, only a few studies are focused on developing visualization techniques to monitor liquid flow in porous media during heating. These facts hamper our understanding of liquid dynamics in porous media as a function of temperature and limit our ability to develop a porous media with a robust design.

In Chapter 1, key aspects of the design strategy of porous materials and methods for incorporating particles into the matrix of thin porous materials, along with the challenges needed to be addressed for each method, are summarized. The state-of-the-art insight into the study of liquid flow movement in porous media is also summarized along with a review of the existing visualization methods.

In Chapter 2, a new technique involving the simultaneous burning of candles and electrospinning was used to integrate soot particles into fibrous polymer membranes. The position of the soot particles within the polymer fibers with submicrometer thickness was controlled by adjusting the injection location of the aerosol particles during electrospinning. The study demonstrated that the placement of the soot particles had no impact on the performance of photothermal conversion. When the resulting solar distillation membranes were applied to the water surface, there was a significant 194.5% improvement in heat localization compared to water samples without membranes. The membranes exhibited water evaporation and desalination rates of up to 1.60 and 1.59 $kg.m^{-2}h^{-1}$, respectively under 1-sun solar irradiation.

In Chapter 3, a novel approach utilizing an optical coherence tomography (OCT) system, combined with a heating chamber connected to an air pump suction line, has enabled the non-destructive and real-time observation of the penetration and evaporation of viscous liquid within porous biomass during heating. The OCT tomogram allows for the visualization of liquid movement within tobacco-based layers over different time intervals, and the quantification is achieved through the attenuation coefficient of the sample at specific temperatures and times. By subjecting the time-lapse attenuation coefficient data to a statistical procedure, such as Duncan's multiple range test, the transitional points during penetration and evaporation at each temperature could be estimated. This analytical system provides an appealing alternative for tracking liquid transport in porous biomass under contact heating conditions, while also contributing to the comprehension of inward and outward mass transfer processes.

This dissertation demonstrates new methods to design thin porous materials and to visualize the interaction between the thin porous materials with liquid under heating. The findings can aid the development of a thin porous material with a rational design.