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MIE RESONANCE-BASED CONTINUOUS HEATING MICROWAVE SYSTEMS

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Microwave heating has received increased attention recently due to its advantages over conventional heating like volumetric heating (vs. surface heating), non-contact heating and fast on/off switching [1]. The main challenge of microwave heating systems is to have a controlled and efficient heating process. Presently, we propose two continuous heating microwave systems operating at 2.45 GHz for heating of water/liquids from 0 to 100 °C. The systems exploit water’s high permittivity to excite Mie resonances in cylindrical containers. This approach is slightly different than existing continuous heating microwave systems consisting of cylindrical applicators [2]. In order to preserve high absorption through the whole heating process, cylinders of different sizes are needed for different temperatures of water. This is in order to account for the temperature dependence of water permittivity; we find that four cylinders are sufficient. The systems are shown in Fig. 1 with one consisting of four connected cylinders in a single WR-430 waveguide channel (a), whereas the other consists of four cylinders going through four waveguide channels (b). A metal plate is placed behind the cylinders to cancel the transmission and effectively increase the absorption. As the water flows through each cylinder (a) or waveguide channel (b), water is heated 25 °C. The results are illustrated in Fig. 1 by the absorption efficiency and power loss density. The absorption scales with the electric field intensity, and therefore it is largest in the center part of the waveguide. The flow rate of the systems is defined by the input microwave power and the absorbance of each cylinders. We find that the total efficiencies are 86 % (a) and 93 % (b), which is far better than e.g. a slab of water (42 %). The systems can be used for heating, pasteurization and sterilization of liquids. Further details on these results will be included and discussed in the paper and presentation.

Fig. 1. Sketch of the configuration and results.

References
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2. IMS, Cylindrical Heating System, online: http://www.industrialmicrowave.com/