Laser ablation as a tool for fragmentation of active pharmaceutical ingredient particles

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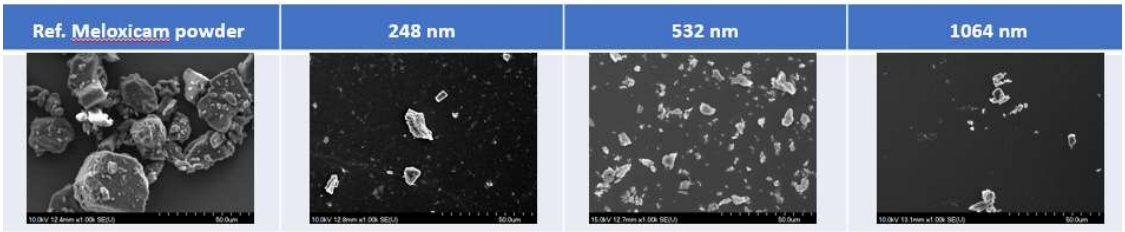
Approximately 40% of marketed pharmaceutical active ingredients and 90% of those under development belong to poorly water-soluble compounds. This trend in active ingredient development presents a challenge to the pharmaceutical industry, as poor solubility limits bioavailability in most cases. By reducing the particle size, the active surface increases, which generally improves the dissolution rate and transport characteristics, so that human cells can absorb the active ingredient faster and more efficiently. Various methods have been developed for the fragmentation, however it is difficult to obtain particles with sizes below few micrometers. Pulsed laser ablation is suitable for producing micro- and nanometer-sized particles from bulk material. With the appropriate choice of laser parameters and experimental conditions, we can find examples for the production of both organic and inorganic particles.

In our experiments we were able to significantly reduce the size of the particles of poorly water-soluble non-steroidal anti-inflammatory and pain-relieving active substances (ibuprofen, niflumic acid and meloxicam) by laser ablation in ambient air (PLA) and distilled water (PLAL). In this process, lasers with different wavelengths and pulse lengths were used to ablate tablets pressed from commercially available powders. Using FTIR and Raman spectroscopy, we confirmed that the chemical composition of the produced particles is the same as that of the original pharmaceutical active ingredients. We have shown that the solubility and anti-inflammatory effect of the laser-shredded particles are better than those of the powders of the reference active ingredient. The material removal process following the laser irradiation was studied with help of fast photographic imaging.



SEM pictures of the reference and the PLAL produced meloxicam particles using different laser wavelengths.

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