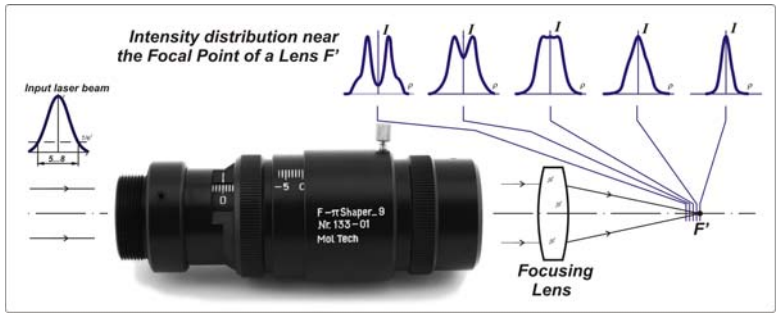
Focal-πShaper for Advanced Flat Top Laser Heating System

(based on materials provided by the courtesy of Consortium for Advanced Radiation Sources, University of Chicago, Chicago, IL, USA)

The Laser Heating technique plays an essential role for *in-situ* high pressure high temperature studies of the physical and chemical properties of materials in the diamond anvil cell (DAC) and minerals at conditions relevant to the Earth's deep interior.

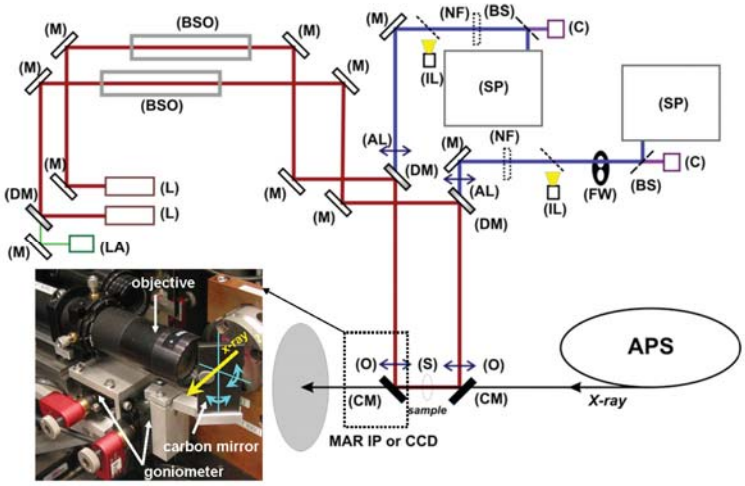
Realistic simulation of heating effects with using a laser can be achieved when the Flat Top intensity distribution of a laser beam is provided. Just this task is solved by ***Focal-πShaper*** (or ***F-πShaper***) – series of refractive beam shapers realizing so called field mapping approach with using aspheric optical surfaces and intended to convert the Gaussian beam profile of a TEM_{00} laser, like the fiber laser, to flat top and other intensity profiles in zone of focal plane of a diffraction limited lens.



Example of optical setup to realize the ***Flat Top Laser Heating (FT-LH)*** is presented on right figure. Here the sample ***S*** is irradiated from two sides by the laser radiation from two fiber lasers ***L*** by means of the diffraction limited objective lenses ***O***.

The initial Gaussian laser beam is converted, by means of the beam shaping optics ***BSO*** on the base of the ***F-πShaper 9_1064,*** to the beam which intensity distribution is optimized to create the flattop profile on the sample ***S***.

Other details of this optical setup as well as detailed description of the results achieved can be retrieved from the article*.



On the right bottom figure there are presented comparative results of Laser Heating of tungsten foil by:

- a focused TEM_{01} beam (left column),
- a flattop beam created from a TEM_{00} beam of fiber laser with using the ***F-πShaper 9_1064*** (two right columns).

The laser power is stepwise increased in top-down direction.

Brightness of dots corresponds to the temperature.

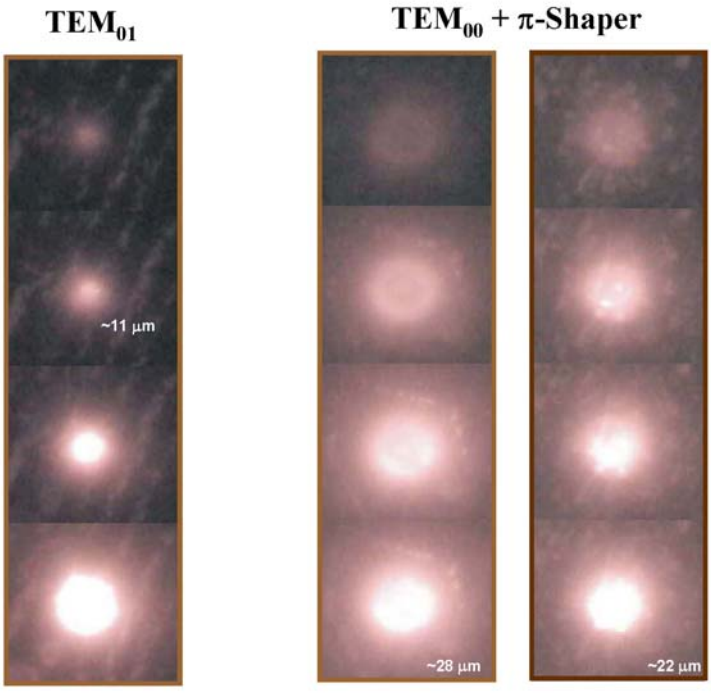
In case of "pure" TEM_{01}:

- varying the laser power leads to evident variation of dot diameter,
- the range of dot diameters is extremely wide,
- temperature distribution within a dot is non-uniform.

Note: in case of "pure" TEM_{00} beam the dot diameter variation is even stronger.

In case of flattop beam:

- the dot size is almost invariable by varying the laser power,
- the temperature is uniform all over the dot,
- varying the laser power leads to corresponding varying of the dot temperature.



Evidently, applying the ***F-πShaper 9_1064*** lets it possible to realize the ***Flat Top Laser Heating (FT-LH)*** and provide most stable conditions for experimental investigations of physical and chemical properties of materials.

** - Prakapenka, V. B., Kubo, A., Kuznetsov, A., Laskin, A., Shkurikhin, O., Dera, P., Rivers, M. L. and Sutton, S.R. (2008) 'Advanced flat top laser heating system for high pressure research at GSECARS: application to the melting behavior of germanium', High Pressure Research, 28:3, 225—235*

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AdlOptica GmbH

Rudower Chaussee 29, 12489 Berlin Germany
Tel.:+49-30-6779888 Fax:+49-30-67798884
E-mail: info@adloptica.com alex@adloptica.com