Objectives:

A research study conducted a leading university in North America compared the effect of distance on beam width and irradiance from seven curing lights at distances from zero to 10mm from the end of the light guide.

Methods:

Seven commercial curing lights were used:

1. 3MESPE: Elipar S10
2. Ivoclar-Vivadent: BluePhase 20i
3. Kerr: Demi
4. Discus: Magna Light
5. DenMat: Sapphire
6. Dentsply: SmartLite PS
7. Ultradent: VALO – Plasma Emulation Mode

The total power output from each light was first measured using a NIST referenced meter, a Coherent PM-10 thermopile. The emitting end of each LCU was held in close approximation to the detector surface. In all cases, the detector surface diameter exceeded the beam diameter from the light. The experiment was repeated twice in a random order of lights.

Mean Power Values

LIGHT	Mean Power mW
SmartLite PS	451
Bluephase 20i	547
DEMI	566
3M S10	722
Sapphire	1080
Magna	1119
VALO (P)	1717

Distribution of Irradiance from the Curing Lights

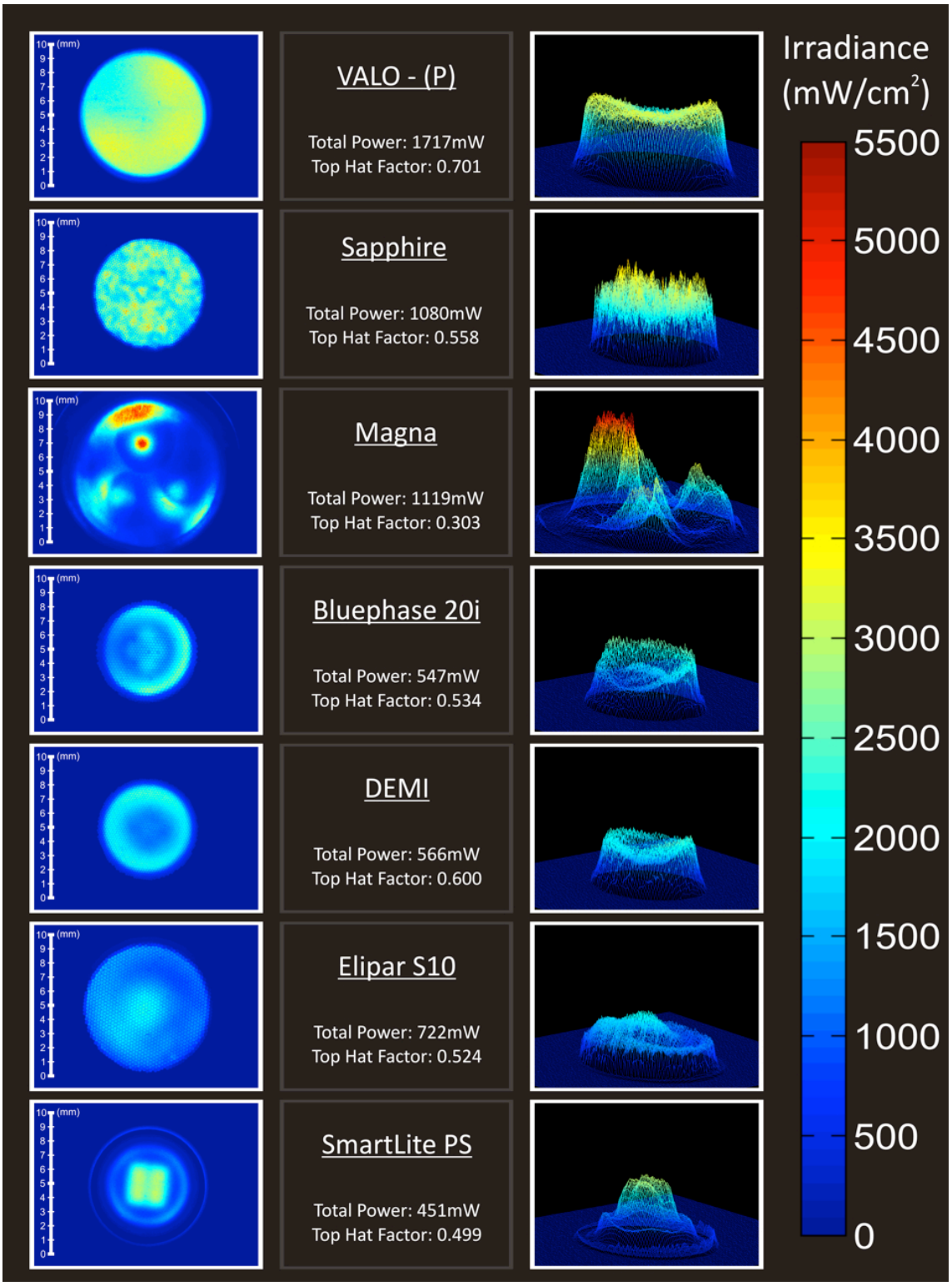
The distribution of power across the tip end from each curing light was determined twice in a random order using an instrument designed to characterize light beams (LBA-USB-L070 Beam Profiler, Ophir-Spiricon, Logan, UT). The lensed CCD camera was held at a fixed distance and focused onto the plane of the frosted surface of a translucent, ground glass target (DG2X2-1500, Thor Laboratories, Newton, NJ). The light-emitting end of each curing light was placed in contact with the frosted surface of the target and the resulting image was monitored on the computer screen. Prior to beam imaging, the pixel dimensions were calibrated, enabling precise

linear measurement of images at the target plane. Thus, the beam images had the same linear dimensions. Data were analysed using the LBA-USB-SCOR v. 4.84, Ophir-Spiricon software (included on the disc) on a personal computer. Prior to each measurement, the system was corrected for ambient light and pixel response (UltraCal, Ophir-Spiricon). When the system and light were ready, the curing light was activated, and the lens iris was manually adjusted so that the full dynamic range of light falling on the array was obtained (8-bit resolution). The Spiricon software calculated the Top Hat Factor (THF) for each image.

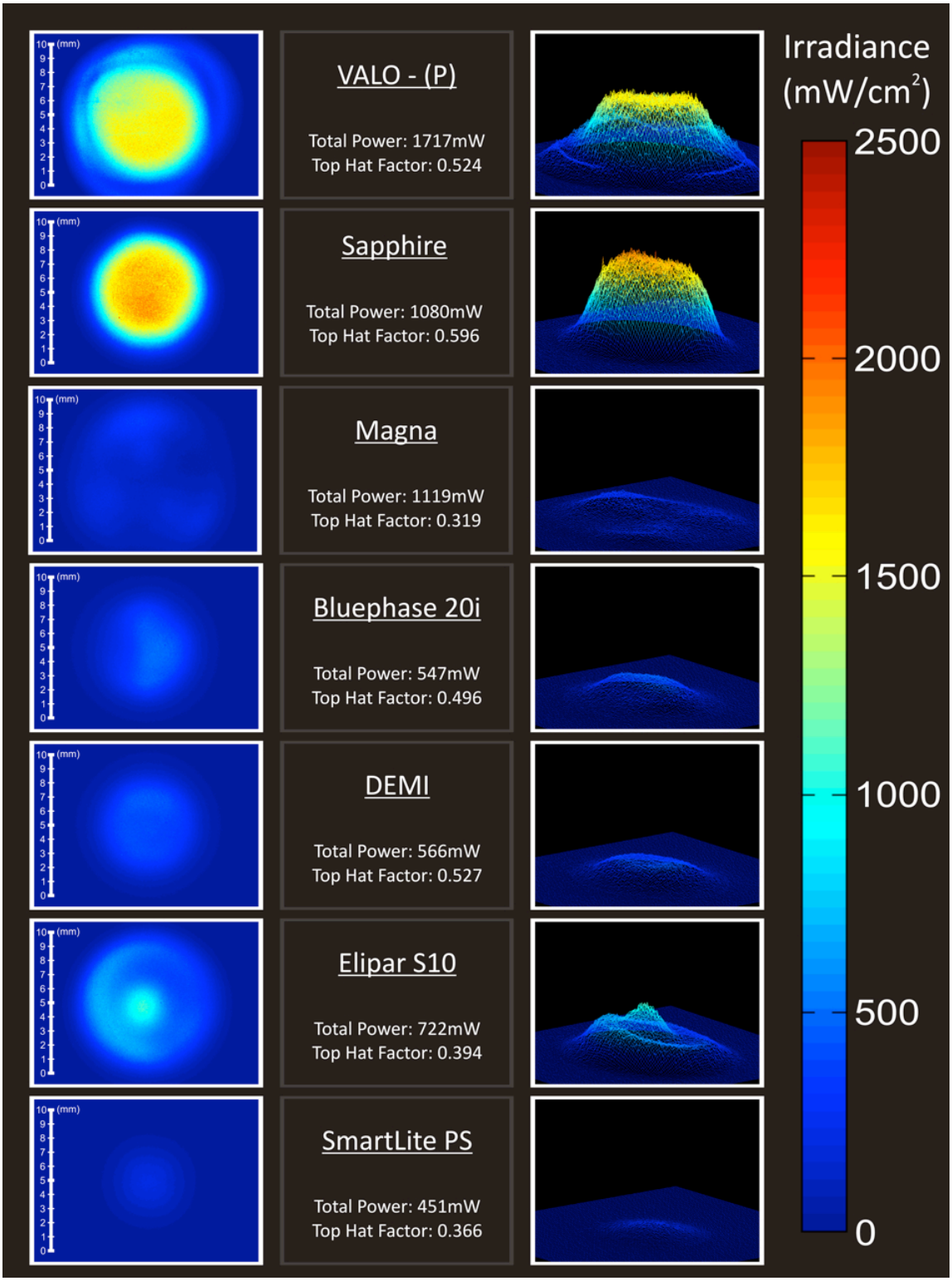
Results:

At 0mm the Valo on the Plasma power setting delivers the greatest power of 1717mW and with a high THF of 0.70. The SmartLite PS delivers the lowest power of 451mW with a low THF of 0.50. While the Magna delivers a relatively high power of 1119mW with some very high irradiance peaks, the irradiance is low over most of its tip area, as is evident by its low Top Hat Factor of 0.30.

0mm Results:


VALO - (P)
Total Power: 1717mW
Top Hat Factor: 0.701
Sapphire
Total Power: 1080mW
Top Hat Factor: 0.558
Magna
Total Power: 1119mW
Top Hat Factor: 0.303
Bluephase 20i
Total Power: 547mW
Top Hat Factor: 0.534
DEMI
Total Power: 566mW
Top Hat Factor: 0.600
Elipar S10
Total Power: 722mW
Top Hat Factor: 0.524
SmartLite PS
Total Power: 451mW
Top Hat Factor: 0.499
Irradiance (mW/cm²)
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0

10mm Results:



These images show clearly how at 10 mm the Sapphire and Valo on the Plasma power setting deliver the greatest irradiance and the most useful light outputs.

Conclusion

In summary, this report measured 7 lights x 2 repeats x 2 distances = 28 individually scaled 2D and 3D images and 2 power measurements using a NIST referenced thermopile. The beam images are all on the same scale with the Magna delivering the greatest irradiance at 0mm, but this was just at a few locations across the end of the light. This resulted in a very low THF for the Magna. At 10mm the scales are different compared to 0mm. The images show that the Sapphire and VALO on Plasma mode are comparable and deliver a far superior relatively even irradiance distribution across the beam at 10mm compared to the other lights tested.