

Laser Shock Interface Strength Characterization of MP-1 Fresh Fuel Plates

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Understanding plate fuel performance in nuclear reactors is essential for developing new fuel systems. This includes characterizing fuel plates before and after irradiation. Idaho National Laboratory's (INL) laser shock system (LSS) enables researchers to quantify the strength of the interface between fuel and cladding by measuring the cladding surface velocity created by a laser induced acoustic shockwave. The work is expanding to include investigation of a new technique to test cladding/cladding interface bonds, which are much stronger and cannot be reliably broken by a single laser shock.

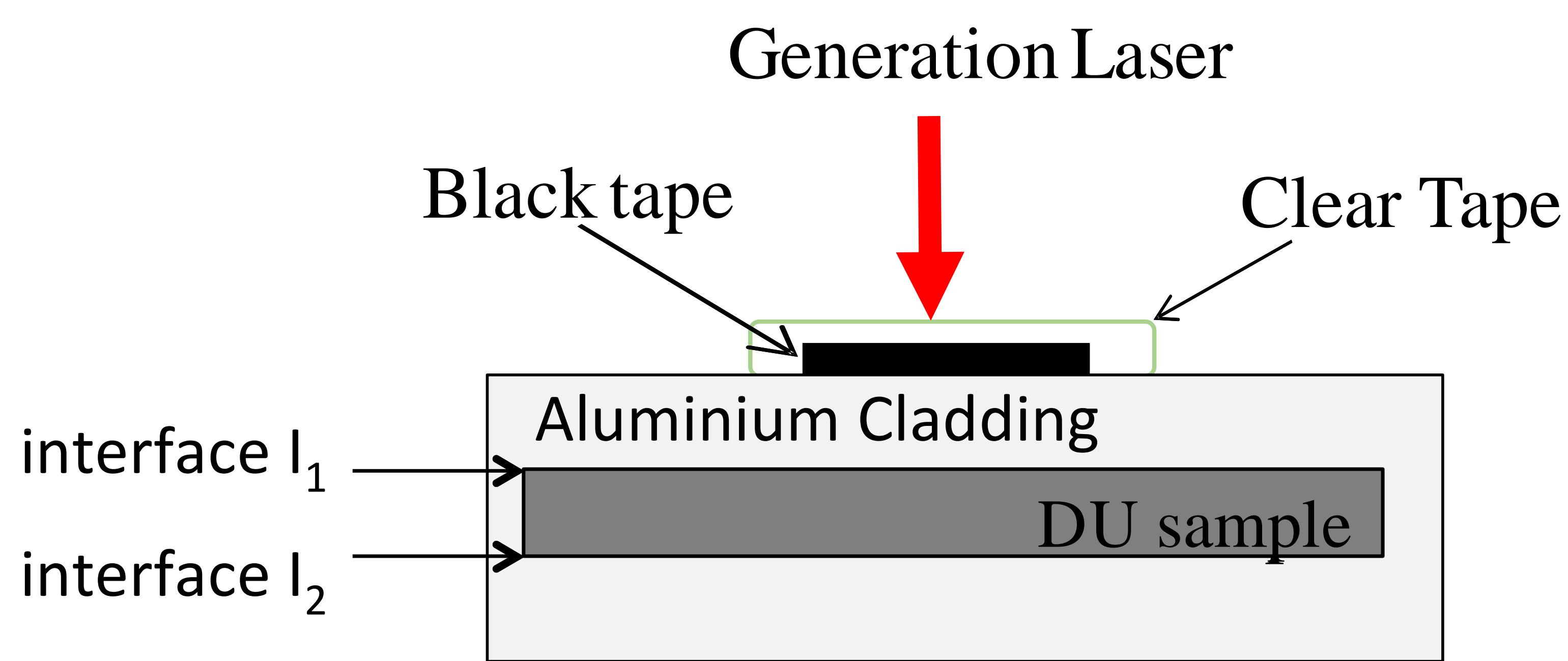


Fig. 1. Schematic of a plate-fuel specimen, geometry, and plasma-constraining mechanism.

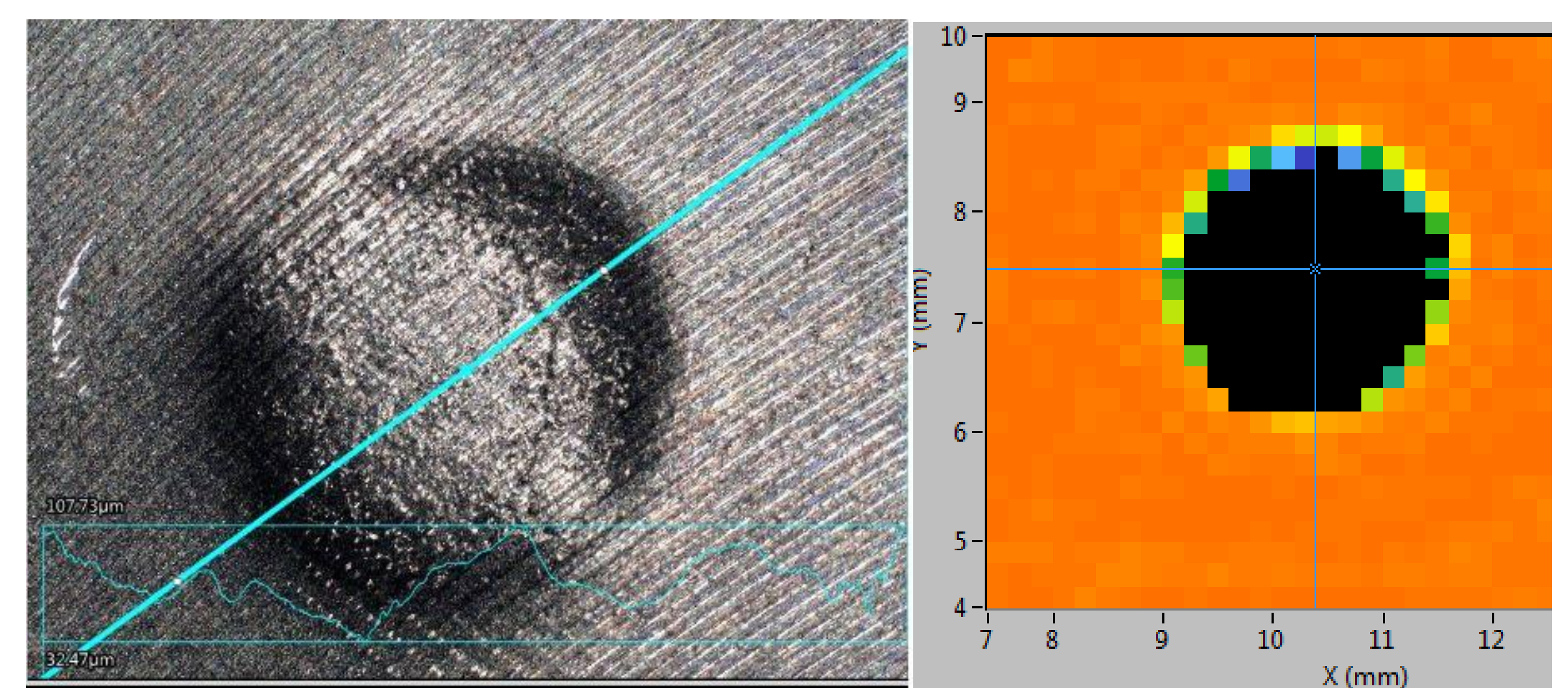


Fig. 3. Images of a fuel plate post-LSS interrogation, showing surface deformation and LUT debond images.

Shot Point	Nominal Laser Energy (J)	1st Shot velocity (m/s)	1rst Shot HEL velocity (m/s)	Shot number of debond
7	2.3	157.5	24.7	2
8	2.4	163.3	19.9	1
10	2.25	171.1	21.1	3
11	2.4	165	20	2
average	2.34	164.2	21.42	2
std	0.075	5.6	2.25	0.82

Table 1. Fuel plate interrogation results for LSS shot locations within the virtual plate positions of Fig. 4. Hugoniot Elastic Limit (HEL)

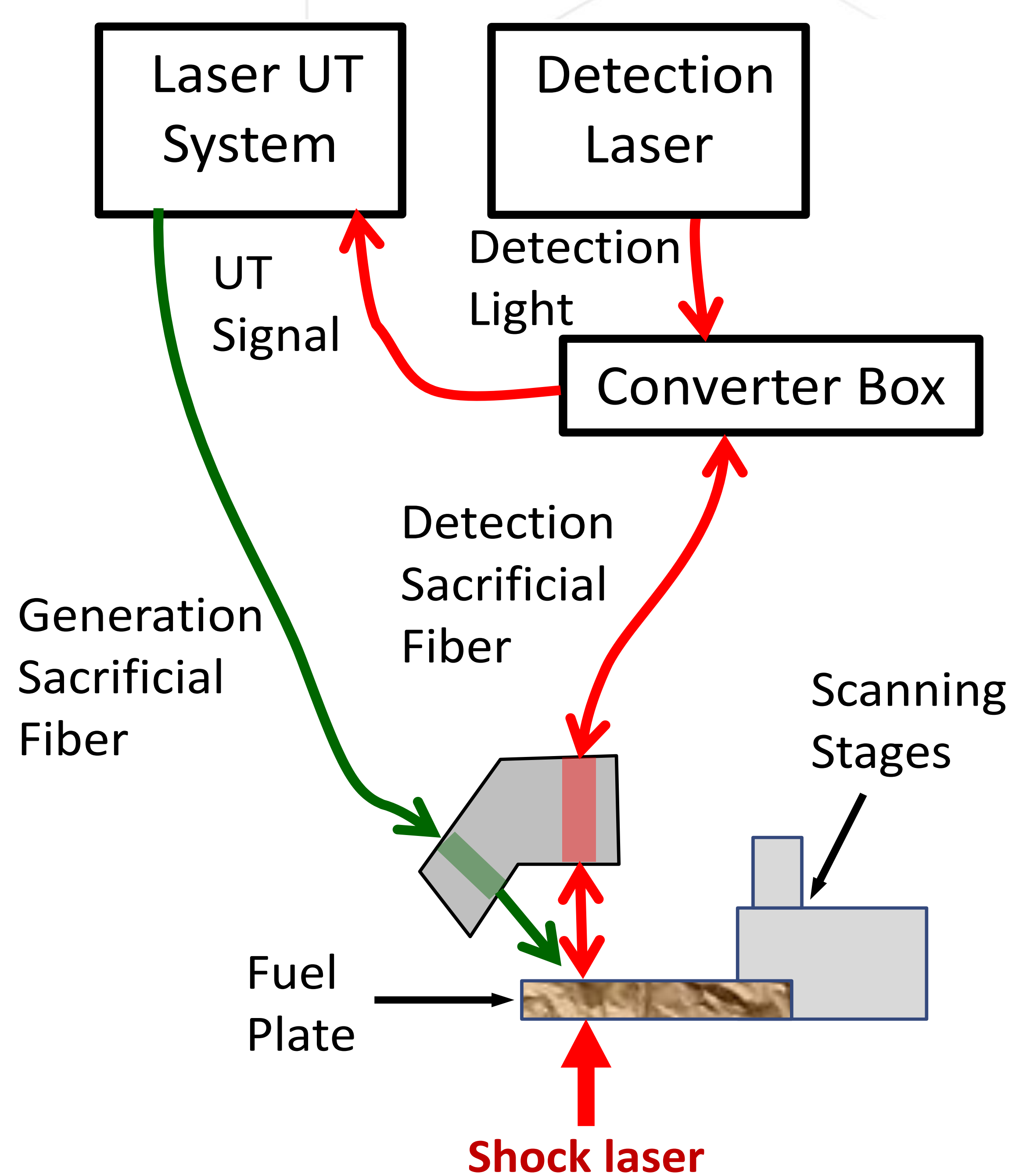


Fig. 2. LSS consists of the shock laser and the laser ultrasonic (LUT) subsystem. The converter box allows for the use of sacrificial fiber optic cables that go into the hot cell.

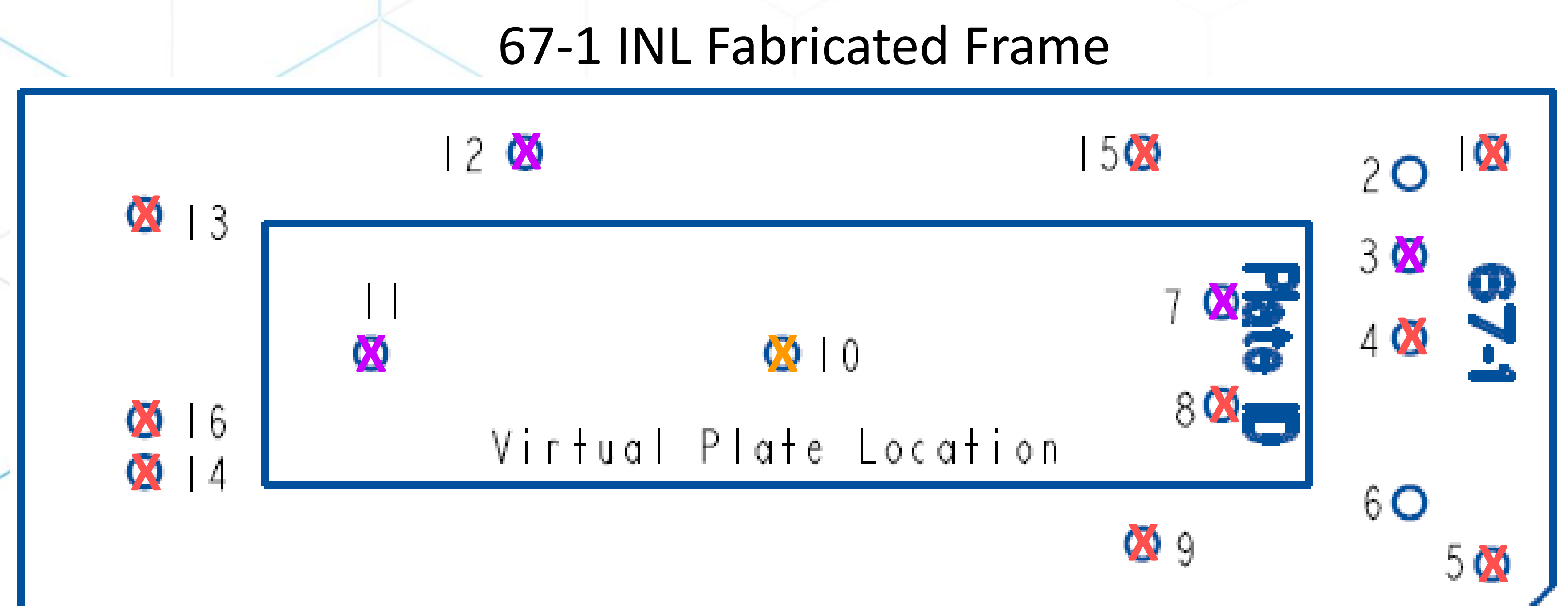


Fig.4 . Pictorial of bond strength mapping showing spatial variations in bond strength .