**Numerical Comparison of CO2 and Fiber Laser Welds at Different Power Inputs**

Muhammad Sohaila1\*, Suck-Joo Naa, Andrey Gumenyukb and Michael Rethmeierb

a Department of Mechanical Engineering, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, 305-701, Republic of Korea

b Division 9.3, BAM, Unter den Eichen 87, 12205 Berlin, Germany

1Department of Materials Engineering, NEDUET, University Road, Karachi 75270, Pakistan

\*Corresponding Author.

### Abstract (300 word limit)

Fiber lasers are one the emerging laser sources available with compact size and high power. Numerous experimental studies are available that discuss the effect of various parameters such as welding speed, power, energy input, etc. for fiber laser welding but not much studies are available that explores the simulation domain of fiber laser welding. The reason is the complex nature of welding phenomenon that required the treatment of all three phases of solid, liquid and gases combined with different sources of energy. In the past years, Na Suck Joo et. al. has published numerous research articles that deals with the computational fluid dynamics of Gas Metal Arc Welding, CO2 Welding, Hybrid welding and fiber laser welding. In the present papers different parameters that can affect the weld behavior and how the modeling techniques can reflect the physical phenomenon would be discussed. Experiments have shown that fiber laser welding phenomenon is different from CO2 Laser welding thus the models used for CO2 laser welding can not be applied to the simulations of fiber laser welding. The main heat source in both welding in Fresnel reflection but the amount of energy transferred in each reflection is somewhat different, our study reveals that fiber laser transfer most of its energy in first few reflections while CO2 laser needs more reflections to transfer the same amount of energy. The bead shape of fiber laser welding is considerably different on the upper part of the weld bead. In CO2 Laser welding bead width is generally twice as compared to bead at other part while the experiments with fiber laser, upto 19 kW, do not show this type of bead, it is found that this difference of this bead shape is basically the result of difference is the behavior of plasma plume above the weld pool. This plume is modeled as radiation heat source in the simulation and effect of changing the parameters related to plasma plume in both CO2 ­and fiber laser welding would be discussed. Similarly other parameters like re-condensation heat flux and other secondary heat sources also play an important role in modeling of fiber laser welding.  ­­

### 

Figure 1 Fiber laser bead shape at different powers

**Recent Publications**

**Sohail M**, Han S-W, Na S-J, Gumenyuk A, Rethmeier M (2018) Study on the role of recondensation flux in high power laser welding by computational fluid dynamics simulations, Journal of Laser Applications 30, 012013, 10.2351/1.4994246

**Sohail M**, Karhu, Miikka, Suck-Joo, Na, Sang-Woo Han & Kujanp, Veli. (2017). Effect of leading and trailing torch configuration on mixing and fluid behavior of laser-gas metal arc hybrid welding. Journal of Laser Applications. 29. 042009. 10.2351/1.5008304.

**Sohail M**, Han S-W, Na S-J, Gumenyuk A, Rethmeier M (2015) Numerical investigation of energy input characteristics for high-power fiber laser welding at different positions. The International Journal of Advanced Manufacturing Technology. doi:10.1007/s00170-015-7066-6

**Sohail M**, Han S-W, Na S-J, Gumenyuk A, Rethmeier M (2014) Characteristics of weld pool behavior in laser welding with various power inputs. Welding in the World 58 (3):269-277. doi:10.1007/s40194-014-0112-4



Biography (150 word limit)

Dr. Muhammad Sohail is currently working as assistant professor in the department of materials engineering at NED University of Engineering and Technology Karachi 75270, Pakistan. He did his Ph. D. under the supervision of Professor Na Suck-Joo, in 2015 from Advanced Laser, Plasma and Hybrid application lab from Korea Advanced Institute of Science and Technology. During his Ph. D. he worked on the simulations of Laser welding, Gas Metal Arc Welding, Hybrid Welding using commercially available computational fluid dynamics code. The experiments of fiber laser were conducted in renowned institutes like VTT of Finland and BAM of Germany.

Email: [msohailhanif@neduet.edu.pk](mailto:msohailhanif@neduet.edu.pk)