

Supplementary Information:

Characterization of the central channel and its flow
velocity distribution in an analytical Inductively-
Coupled-Plasma source

Xiaobao Mao ¹, Yongyang Su ^{2,*}, Zhiming Li ², Xin Han ¹, Jiang Xu ²,

Wei Wang ², Ruiyang Xi ², Pengfei Zhang ², Xiaofei Lan ^{1,*}

1 School of Physics and Astronomy, China West Normal University,
Nanchong, Sichuan, 637002, China

2 Northwest Institute of Nuclear Technology, P.O. Box 69-14, Xi'an,
Shaanxi, 710024, China

* Corresponding author

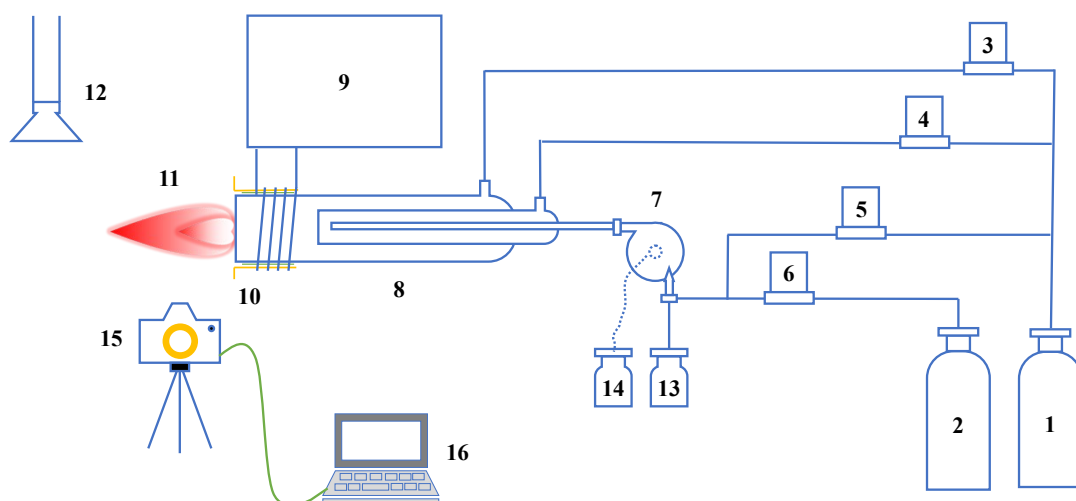
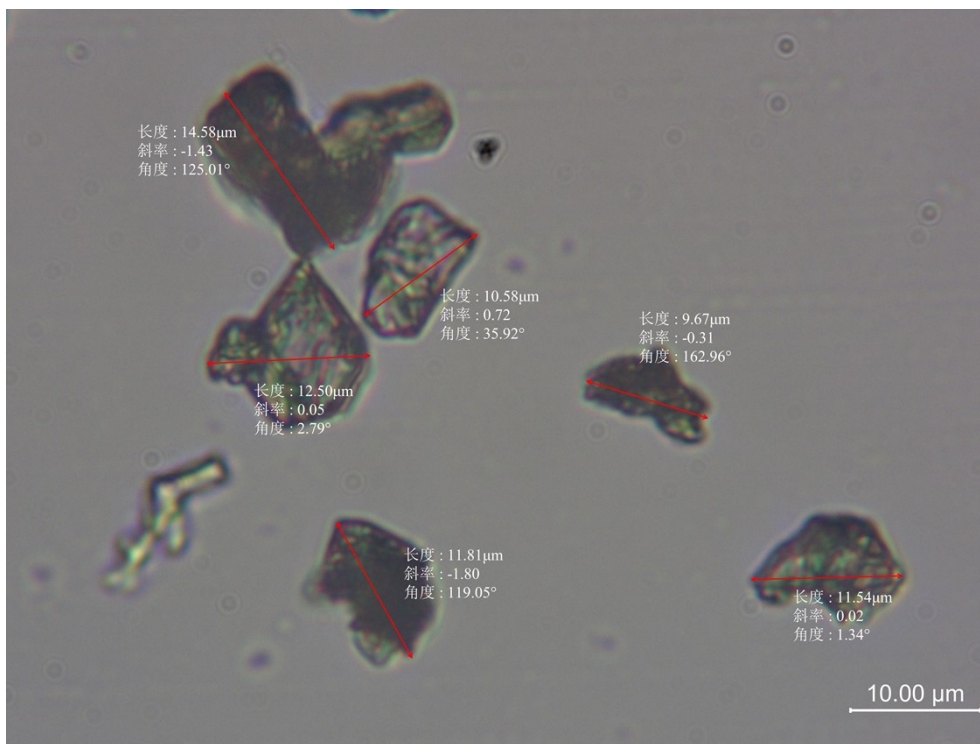
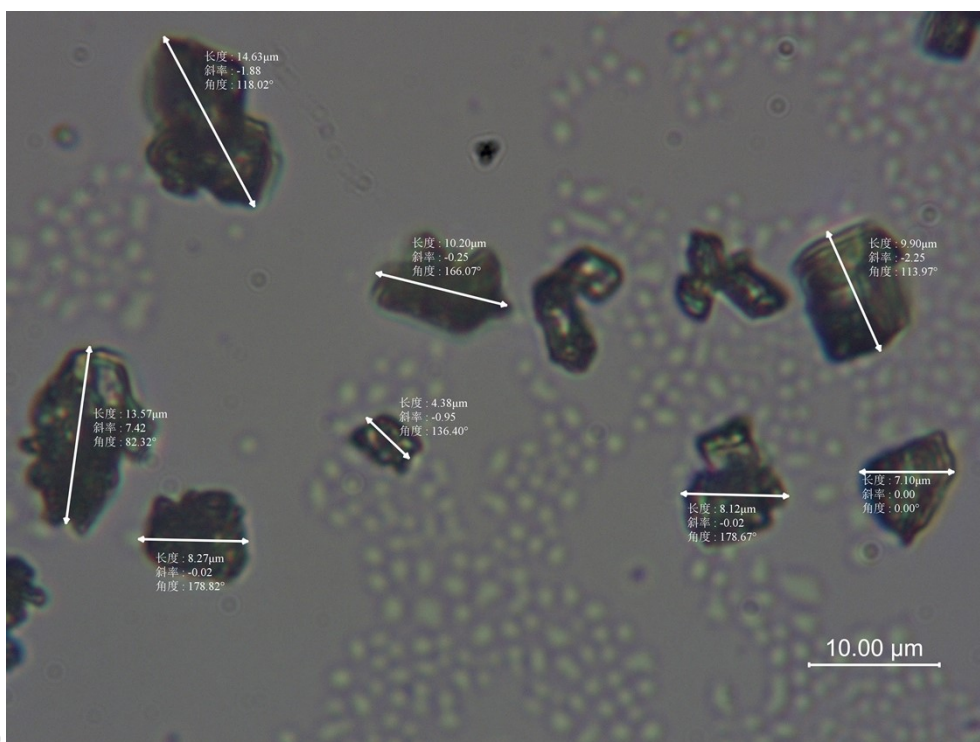


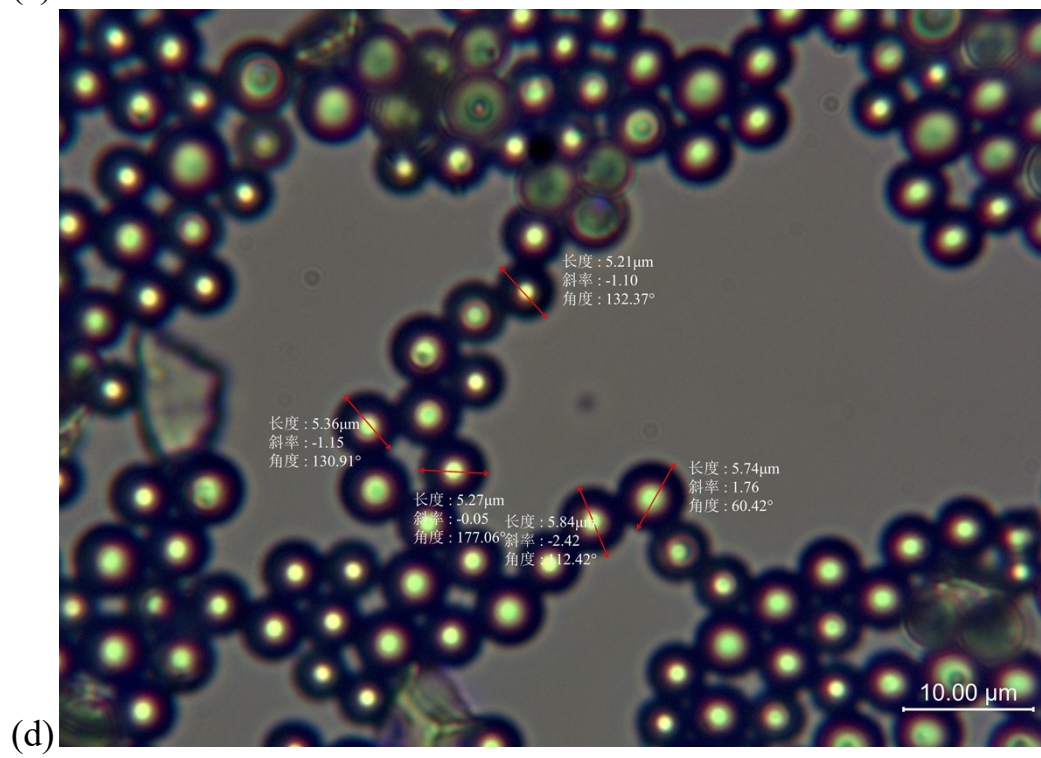
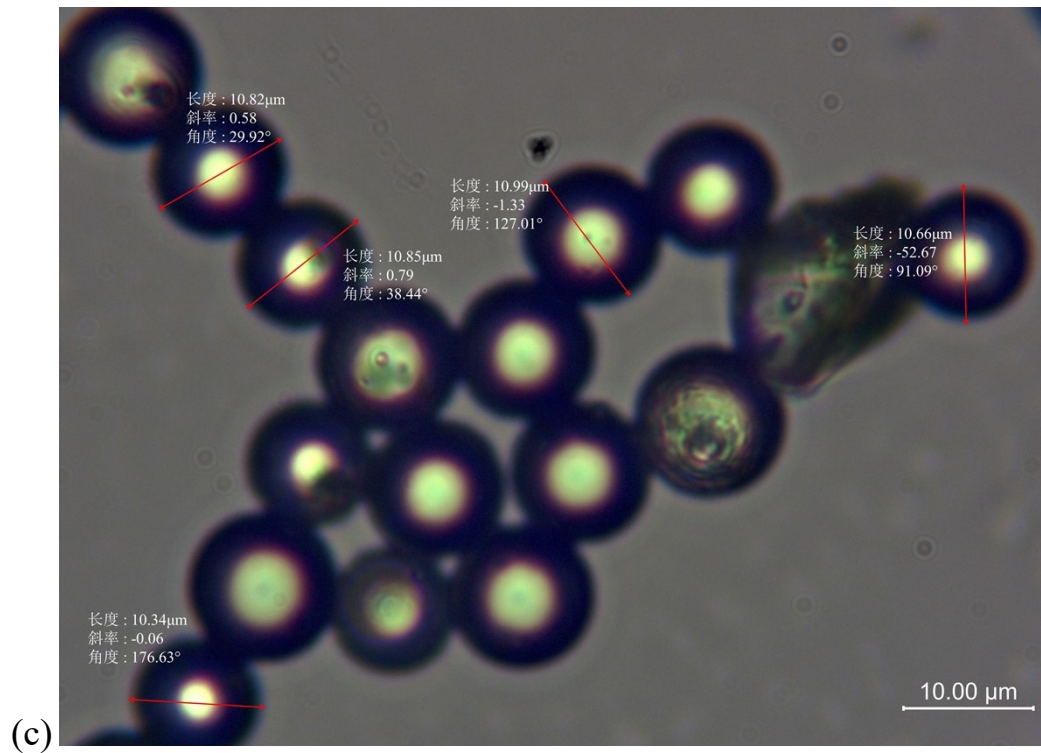
Figure S1 Schematic diagram of the facility. 1 argon gas cylinder, 2 molecular gas cylinder, 3 mass flow controller (MFC) for coolant gas, 4 MFC for auxiliary gas, 5 MFC for sample gas, 6 MFC for added gas, 7 nebulizer and cyclone chamber, 8 quartz torch, 9 r.f. power generator and impedance matching network, 10 shielded plate and bonnet, 11 plasma, 12 exhaust pipe, 13 suspension sample, 14 waste, 15 high-speed colour camera, 16 computer.



(a)



(b)



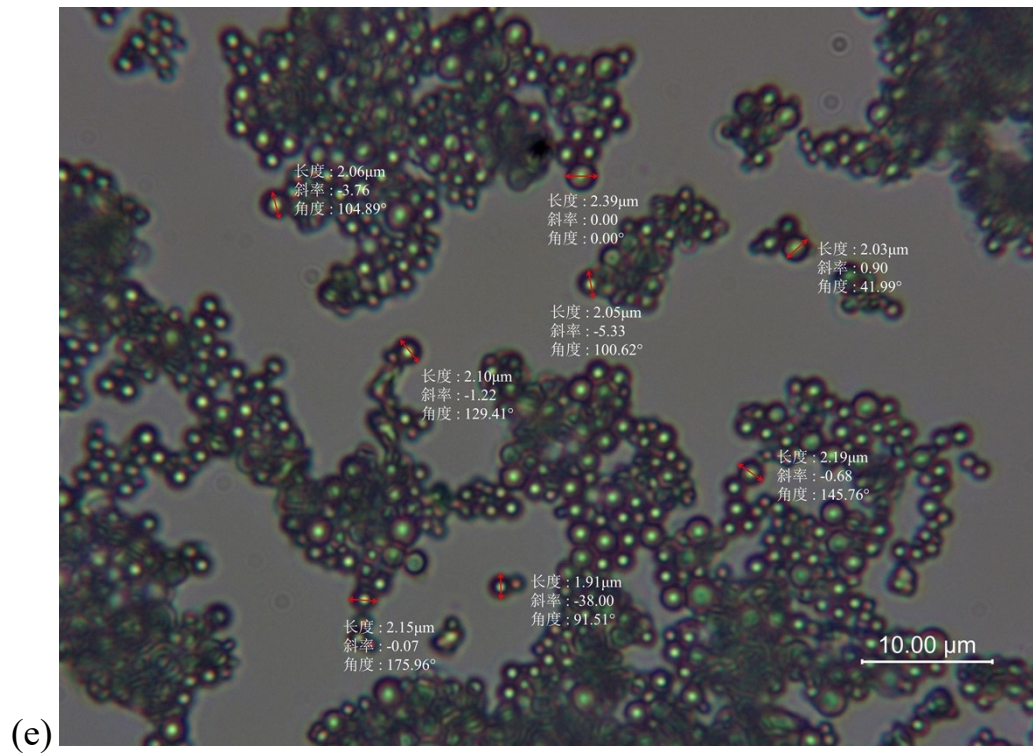
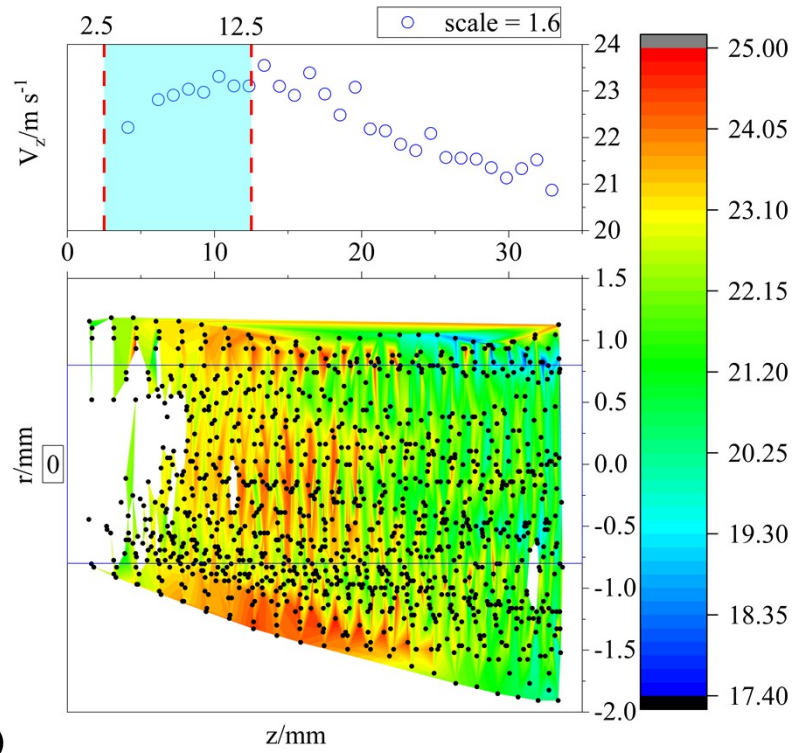
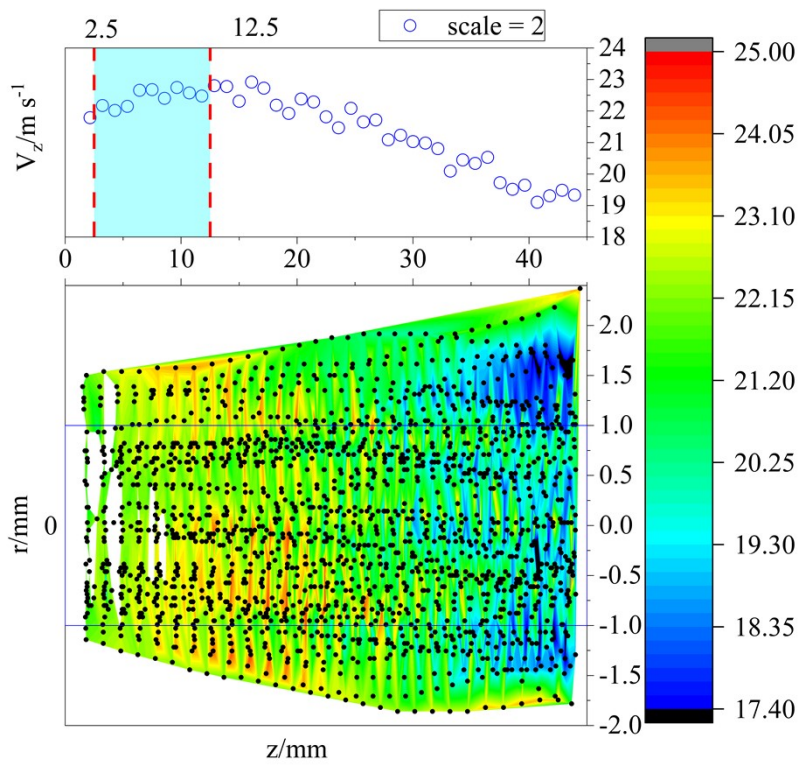


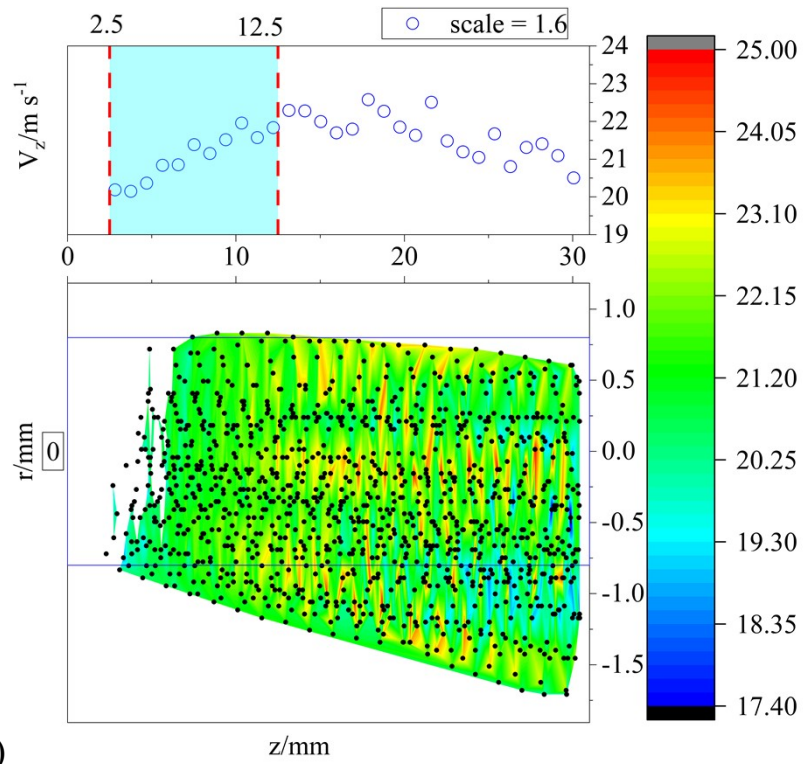
Figure S2 Morphologies of (a) Er_2O_3 , (b) Y_2O_3 , (c) $\sim 10\mu\text{m}$ borosilicate glass (BSG_10), (d) $\sim 5\mu\text{m}$ borosilicate glass (BSG_5), and (e) $\sim 2\mu\text{m}$ borosilicate glass (BSG_2) particles



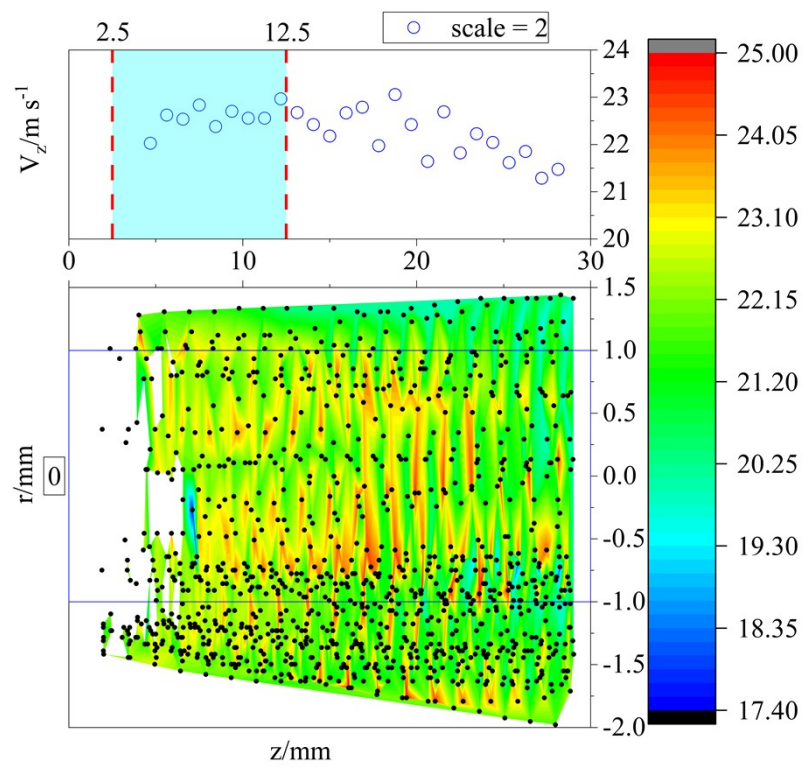
(a)



(b)



(c)



(d)

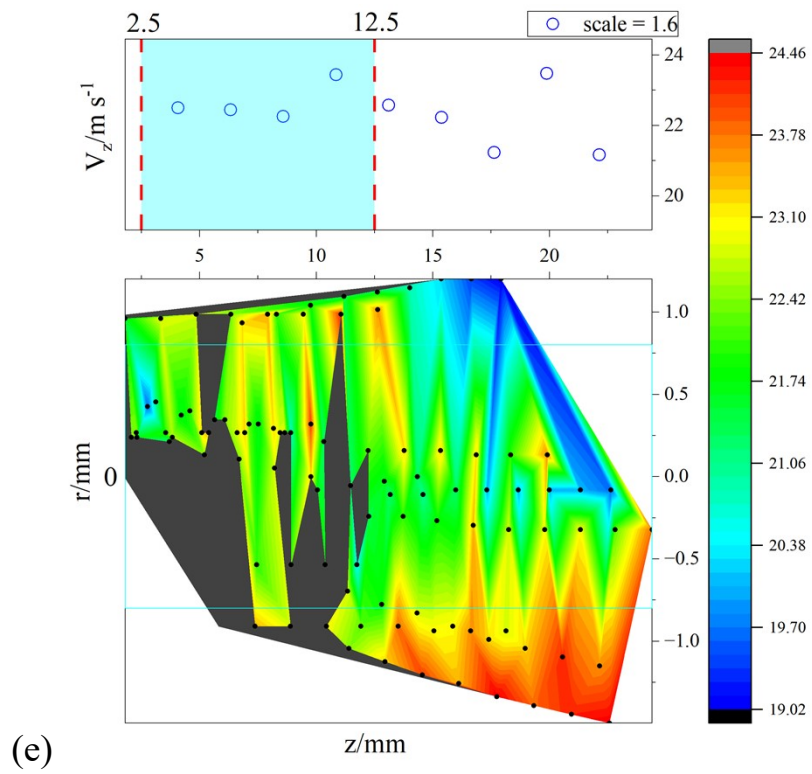


Figure S3 Contour maps and interpolated profiles of axial velocity for Er_2O_3 (a), Y_2O_3 (b), BSG_10 (c), BSG_5 (d) and BSG_2 (e) particle in pure Ar-ICP

Data supporting Figure 4 The radial profiles of gray value at three axis positions ($z=2.5, 5.0$ and 7.5 mm) in pure argon ICP (a) and mixed-gas ICPs with addition of 10%O₂ (b), 20%O₂ (c), 2%N₂ (d), 4%N₂ (e), 6%N₂ (f) in the sample gas

01 Gray value_pure Ar.txt

02 Gray value_10% O2.txt

03 Gray value_20% O2.txt

04 Gray value_2% N2.txt

05 Gray value_4% N2.txt

06 Gray value_6% N2.txt

Data supporting Figure 5 The axial velocity of ion clouds originating from Er₂O₃ (a), Y₂O₃ (b), BSG_10 (c), BSG_5 (d) and BSG_2 (e) particles in the pure argon ICP

07 The axial velocity of Er₂O₃, Y₂O₃, BSG_10, BSG_5 and BSG_2.txt

Data supporting Figure 6 The experimental data (a) and cubic polynomial fitting (b) of the axial flow velocity distribution in the central channel of the pure Ar-ICP

08 Comparison of V_z of Y₂O₃, Er₂O₃, BSG_5 and Er₂O₃ in Han 2025.txt

Data supporting Figure 7 The axial flow velocity distribution in the central channel (a) and the plateau value (b) under varying r.f. powers for pure Ar-ICP. r.f. power setting: 900, 1000, 1100, 1200 and 1300 W.

09 The Vz profiles at 900, 1000, 1100, 1200 and 1300W.txt

10 The plateau value of Vz at varying r.f. power.txt

Data supporting Figure 8 The axial flow velocity distribution in the central channel under sample flow rates of 1.2 (a), 1.0 (b), 0.8 (c), 0.6 (d) and 0.4 (e) L/min for pure Ar-ICP

11 The Vz profiles at sample flow rates of 1.2, 1.0, 0.8, 0.6 and 0.4L min⁻¹.txt

Data supporting Figure 9 The axial flow velocity distribution in the central channel of Ar-O₂ ICP (a) and Ar-N₂ ICP (b)

12 The Vz profiles at 0%, 10% and 20%O₂.txt

13 The Vz profiles at 0%, 2%, 4% and 6%N₂.txt