Which powder material properties, laser process parameters, and part properties should be measured and documented during Metal & Polymer PBF-LB within the SPP 2122?

1. POWDER MATERIALS

Material Properties	Measurement technique
1.a) Strongly recommended:	
Volume-weighted particle size distribution ($x_{10,3(0)}$, $x_{50,3(0)}$, and $x_{90,3(0)}$)	Optical microscopy / SEM / laser scattering / laser particle imaging (combination of 2 complementary methods)
Particle shape distribution (size dependent aspect ratio)	Optical microscopy / SEM
Material composition	SEM-EDX / XRF
Flowability	Rotating drum, Ring shear tester, Hausner ratio, Powder rheometer, Zimmermann powder adhesion tester
Melting and Crystallization temperatures	DSC (10 K/min heating and cooling rate)
If nanoparticles are used as additve:	
Nnaoparticle volume load	ICP-MS / XRF / AAS
Nanoparticle size distribution	TEM / DLS / ADC
If colloidal: Nanoparticle zeta potential	Zeta Sizer
Surface coverage of nanoparticles on micropowders	SEM
Interparticle distance of nanoparticles on the surface of coated micropowders	SEM
1.b) Recommended:	
Nano-composite powder surface composition	XPS, EDX
Laser Absorption and Reflectivity	Ulbricht sphere, FTIR Spectrometer
Structural information	XRD / SEM-EBSD
Melting and Crystallization	Fast-DSC
Additionally for polymers:	
Viscosity (only for polymers)	Rheometer
Melt Flow Index (only for polymers)	MFI device

2. LASER PROCESS PARAMETERS:

2.a) Strongly recommended:

Laser type, laser wavelength, laser spot size ($1/e^2$), relative hatch distance (hatch/spot), specific energy density (laser power per scan speed or laser power per volume), powder layer thickness, scan pattern, hatch strategy, recoating speed, atmosphere (i.e. ppm oxygen), gas flow rate

2. b) Recommended:

Measuring the actual laser output power (behind optics, once per experimental series) and effective scanning speed of the system (once)

3. PART PROPERTIES:

As-built part property	Measurement technique	Responsible Group in Round-Robin studies
Both for polymer & metal parts:		
Composition	XRF	S. Barcikowski
Relative density		
Sectional	Optical Microscopy	F. Walther, M. Schaper
Volumetric	µ-Computed Tomography (µ-CT)	F. Walther
Pore size & distribution		
Sectional	Optical Microscopy	M. Schaper
Volumetric	µ-CT	F. Walther
3D imaging of microstructure	FIB-SEM	H. J. Maier
Status of NPs in the microstructure	SEM, TEM	H. J. Maier
Mechanical strength	Tensile test	G.A. Luinstra, H. J. Meier
Additionally for polymer parts:		
Molecular weight	Gel Permeation Chromatography (GPC)	G.A. Luinstra
Rheology	Rheometer	G.A. Luinstra
Crystallinity	Wide Angle X-ray Scattering (WAXS), Polarized microscope	D. Drummer
Additionally for metal parts:		
Crystal orientation of grains	SEM-EBSD	M. Schaper
Hardness	Vickers Hardness Tester	H. J. Maier
Corrosion resistance	Potentiodynamic test	G. Grundmeier

Where within the SPP 2122 can I get access to the recommended measurement techniques?

Measurement technique	**Available within the SPP, e.g. through the following groups (exemplary):**
Optical Microscopy	All
Scanning Electron Microscopy (SEM)	All
Energy-dispersive X-ray spectroscopy (EDX)	All
Electron backscatter diffraction (EBSD)	M. Schaper, W. Theisen
Laser Diffraction	A. Kwade, M. Lang, J. Schmidt, G. Luinstra, M. Petermann
Dynamic Particle Image Analysis (shape & size distribution)	F. Walter
Dynamic Light Scattering (DLS)	A. Kwade, S. Barcikowski
Analytical Disc Centrifugation (ADC)	A. Kwade, S. Barcikowski
Differential Scanning Calorimetry (DSC)	(almost) All
Differential Fast Scanning Calorimetry (DFSC)	O. Keßler
Zeta Sizer	A.Kwade, S. Barcikowski
Rotating Drum	A. Kwade, J. Sehrt
Ring Shear Tester	A. Kwade, J. Schmidt
Powder rheometer	J. Sehrt
X-Ray Flourescence (XRF)	S. Barcikowski
X-Ray Photoelectron Spectroscopy (XPS)	S. Barcikowski
X-Ray Diffraction (XRD)	(almost) all
MFI/Rheometer	M. Lang, C. Bierwisch, J. Schmidt
FTIR Spectrometer (with heating up to 1000°C)	J. Sehrt
Laser absorbtivity	M. Schmidt