



## Plenary Lecture

Title	Dr.	First Name	Frank	Last Name	Gaertner
Affiliation			Helmut Schmidt University - University of the Federal Armed Forces Hamburg		
Presentation Title			From Basics on Cold Spraying to Solutions for Additive Manufacturing and Repair		
Biography			<p>Frank Gärtner heads the Laboratory of Surface Technology at Helmut-Schmidt-University Hamburg as part of the Institute of Materials Technology. His expertise concerns the formation of metastable phases, as well as mechanisms of coating formation in thermal spray and cold spray techniques.</p> <p>He has pioneered the field of cold – or kinetic spraying since the late 1990ies and holds an internationally well-recognized expertise on exploring the basic mechanisms and on developing applications as well as spray equipment, the latter in close cooperation with industries. Associated research work combines computational fluid dynamics, modelling of deformation and bonding, “in-flight” diagnostics, and various material and surface characterization techniques.</p> <p>He has published more than 140 journal and about 80 conference papers (about 10000 citations, h-index of 39). Up to present, he was responsible for about 15 publically funded R&amp;D projects.</p>		



**Abstract**

The presentation describes the journey from exploring basic principles in cold spraying and arising obstacles to demands in structural applications and solutions to enable applications in repair and additive manufacturing. As a powder spray technique dealing with solid impacts, cold spraying results in coatings of high purity and unique properties, not attainable by other spray methods. When impact conditions exceed critical velocities, bonding of solid particles is enabled by high strain rate deformation and associated heating, which in consequence by thermal softening then leads to localized adiabatic shear instabilities at particle interfaces. As shown by modelling and experiments, properties of the deposit improve with increasing the ratio between individual particle impact velocity and critical velocity at attained impact temperature. By well-tuned impact conditions, electrical and thermal conductivities as well as mechanical strengths similar to those of respective bulk material could be achieved, enabling applications in serial production.

However, new applications of structural parts by cold spray additive manufacturing and repair demand for further developments. Cold sprayed deposits are highly work hardened and still contain non-bonded interfaces as microcracks, both contributing to rather limited ductility and possibly reduced strength. Apart from that, deposit quality decreases with deviation from orthogonal impact angle. These challenges are tackled by well-tuned powder properties, primary spray parameter sets and secondary parameters that govern the surface temperature by direct heating or adjusted robotics, as well as by post treatments. Optimized path planning then enables the transfer to 3D geometries in part repair. The presented concept demonstrates how to include all that into one common digital, automatized environment to enable structural part repair and additive manufacturing. By all-inclusive control, cold spraying should get ready for new applications.