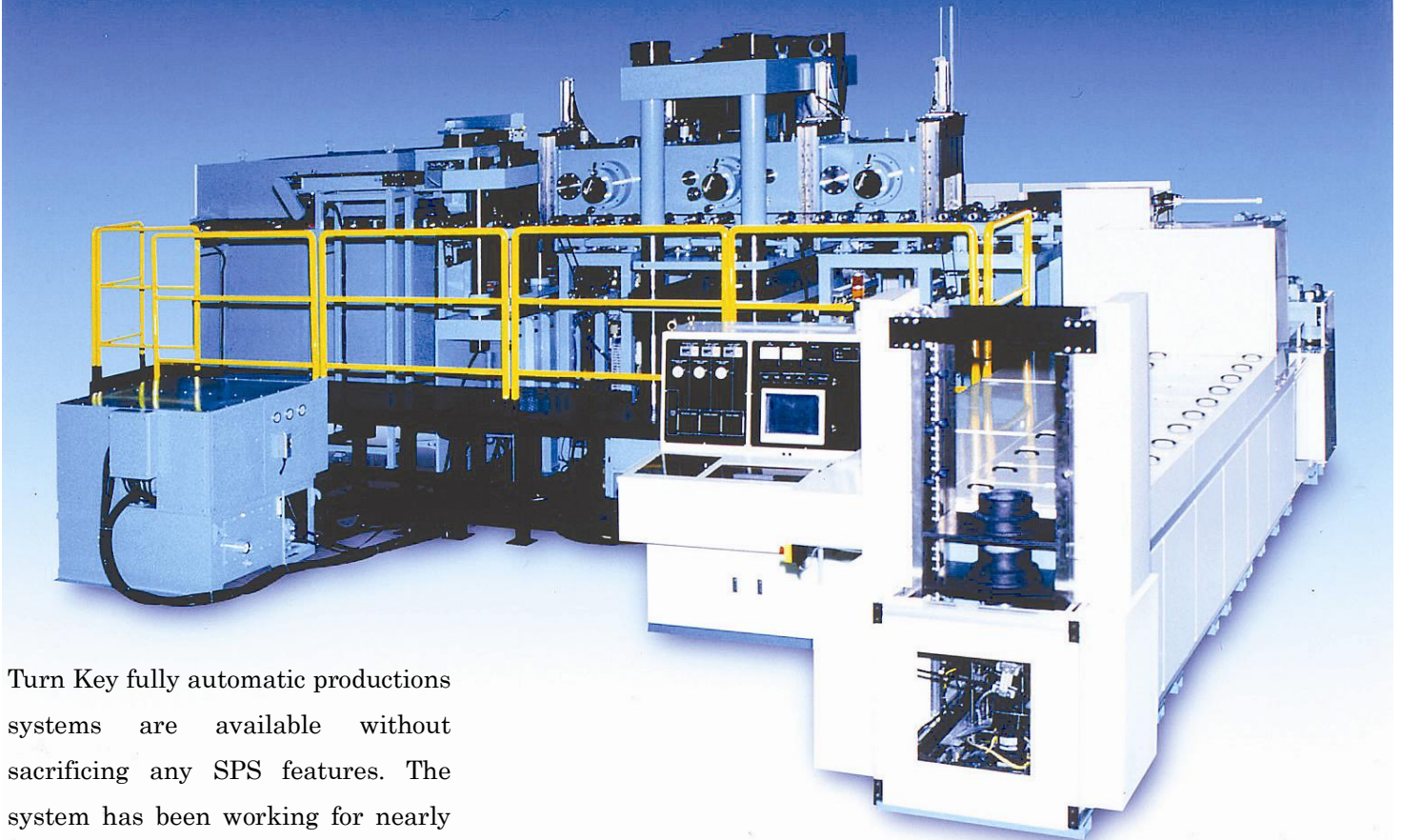
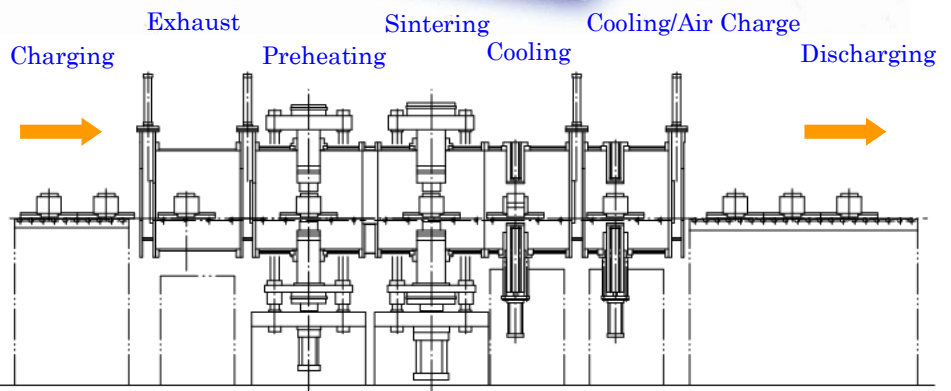


# *From R&D of New Materials to SPS Production Systems*

## Full Automatic Continuous Sintering Production System



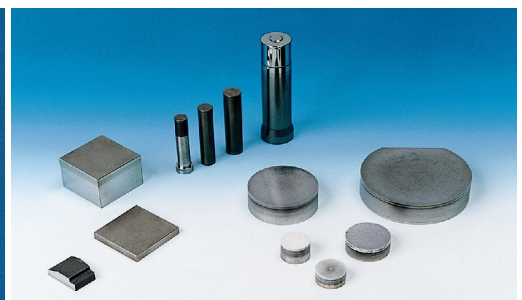
Turn Key fully automatic productions systems are available without sacrificing any SPS features. The system has been working for nearly 10 years for continuous production of ultra-fine super hard WC/Co alloy and advanced ceramics such as Nano-Structured Pure WC. One of the parts made via this unit is a  $100 \times 70 \times 7$ mm WC/Co plate sintered 2 high in a 20min processing time.



ZrO<sub>2</sub>/Stainless Steel FGM  
(100mm diameter)



Large size Al-Si alloy sinter  
(350mm diameter)

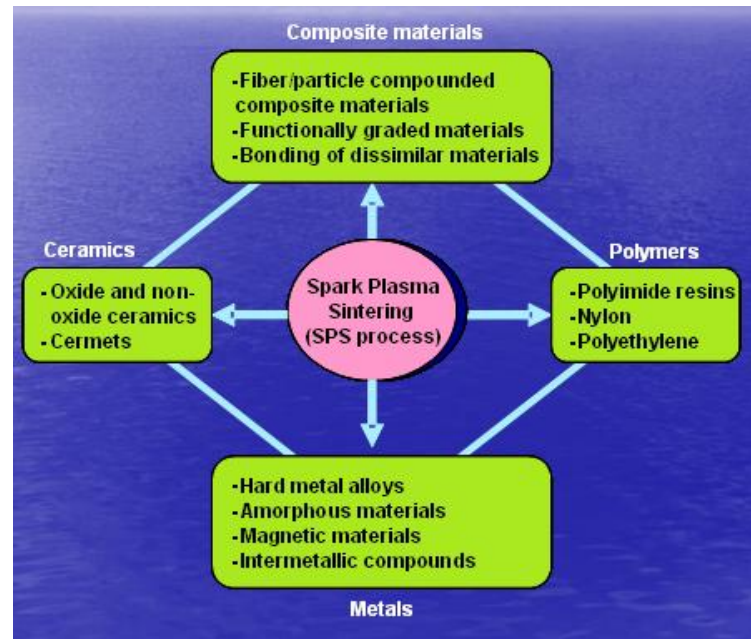


Functionally graded materials

# Principle and Application of SPS Process

The SPS process is designed to provide a sintering of various kinds of materials, from metals to ceramics, in a wide range of pressure and temperature. Various controlled atmospheres can be introduced as well as a vacuum that can reach 6Pa (or  $6 \times 10^{-3}$  Pa/opton). Versatility and adaptability are also shown with the ability to sinter up to 2,400°C under a programmable pressing action of as high as 1 GPa. Within the tooling gradient temperature ranges are also possible allowing for Functional Graded Materials of ceramics, metals and polymers.

The advantage and characteristics of this process are the easy controllability of the parameters to control the microstructure, limit particle growth, capability to process the sinter retardant materials, and the reaction preventing effect between additives and base materials. Given the versatility of the SPS process, the short processing times, the preservation of microstructure, many materials and properties are achievable often times to very high densities.

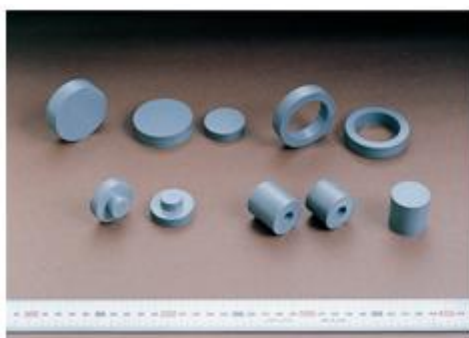


Technical Field to be applied by SPS Process

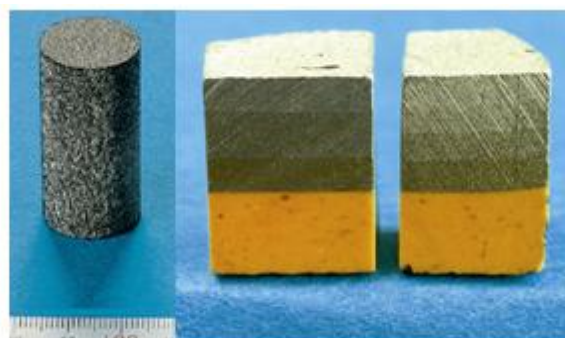
- **Fine Ceramics**  
Oxides, Carbides, Nitrides, Borides and Fluorides
- **Functionally Graded Materials**  
Heat Resistance Graded, Abrasion Resistance Graded, Hardness Graded, Electric Conductivity Graded, Porosity Graded Materials, etc. by means of ceramic-metal system and polymer-metal system
- **Nano-phase Material**  
Metallic Nano-Materials, Ceramics Nano-Materials and Nano-Composite Materials.
- **Super Hard Tool Materials**  
WC/Co Materials, WC/Ni Materials, Ceramics, Cermets Cutting Tools, Corrosion Resistant Materials, Abrasion Resistant Materials, etc.
- **Diamond Tool Materials**  
Segment Grinding Stone, Straight Wheel, Cup Wheel, Cutting Blade, etc. made by Cobalt or Bronze bonding.
- **Biomaterials**  
Implant, Artificial Bone, Artificial Joint, etc. made of Titanium or Apatite.
- **Porous Materials**  
Bioreactor, Filter, Materials for Battery, etc. made of Ceramics or Metal.
- **Mold and Die Materials**  
Stamping Die, Plastic Mold, Drawing Die, and Aspheric Glass Lens Mold, etc.
- **Materials for Electronic**  
Thermoelectric Semiconductor made of Bi<sub>2</sub>Te<sub>3</sub>/PbTe/SiGe/FeSi<sub>2</sub>/CoSb<sub>3</sub> materials, various Sputtering Target Materials, Rare Earth Magnetic Materials, CoSb<sub>3</sub> Dielectric Materials.
- **Other Materials and Parts to be sintered.**

## Suitable materials for SPS processing

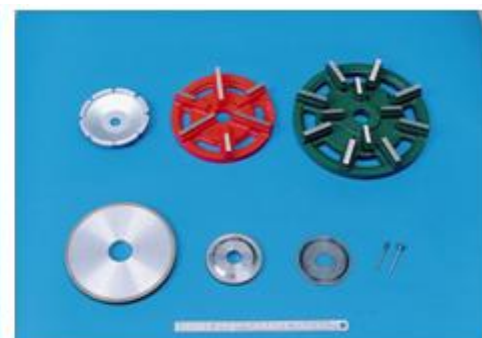
Classification		Materials for SPS processing
Metals		Fe, Cu, Al, Au, Ag, Ni Cr, Mo, Sn, Ti, W, Be, } <b>Virtually any metal possible</b>
Ceramics	Oxides	Al <sub>2</sub> O <sub>3</sub> , Mullite, ZrO <sub>2</sub> , MgO, SiO <sub>2</sub> , TiO <sub>2</sub> , HfO <sub>2</sub>
	Carbides	SiC, B <sub>4</sub> C, TaC, TiC, WC, ZrC, VC
	Nitrides	Si <sub>3</sub> N <sub>4</sub> , TaN, TiN, AlN, ZrN, VN
	Borides	TiB <sub>2</sub> , HfB <sub>2</sub> , LaB <sub>6</sub> , ZrB <sub>2</sub> , VB <sub>2</sub>
	Fluorides	LiF, CaF <sub>2</sub> , MgF <sub>2</sub>
Cermets		Si <sub>3</sub> N <sub>4</sub> + Ni, Al <sub>2</sub> O <sub>3</sub> + Ni, ZrO <sub>2</sub> + Ni Al <sub>2</sub> O <sub>3</sub> + TiC, SUS + ZrO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> + SUS SUS + WC/Co, BN + Fe, WC + Co + Fe
Inter metallic compounds		TiAl, MoSi <sub>2</sub> , Si <sub>3</sub> Zr <sub>3</sub> , NiAl, NbCo, NbAl, LaBaCuSO <sub>4</sub> , Sm <sub>2</sub> Co <sub>17</sub>
Other materials		Organic materials (polyimide, etc), Composite materials



Si<sub>3</sub>N<sub>4</sub>/Al<sub>2</sub>O<sub>3</sub> wear-resistant parts



Porus titanium Metal-polymer FGMs materials



Metal-bonded diamond grinding wheel