SG/TG abrasive grains mechanism and application

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What's Ceramic Abrasive (Alumina produced by ceramic process)

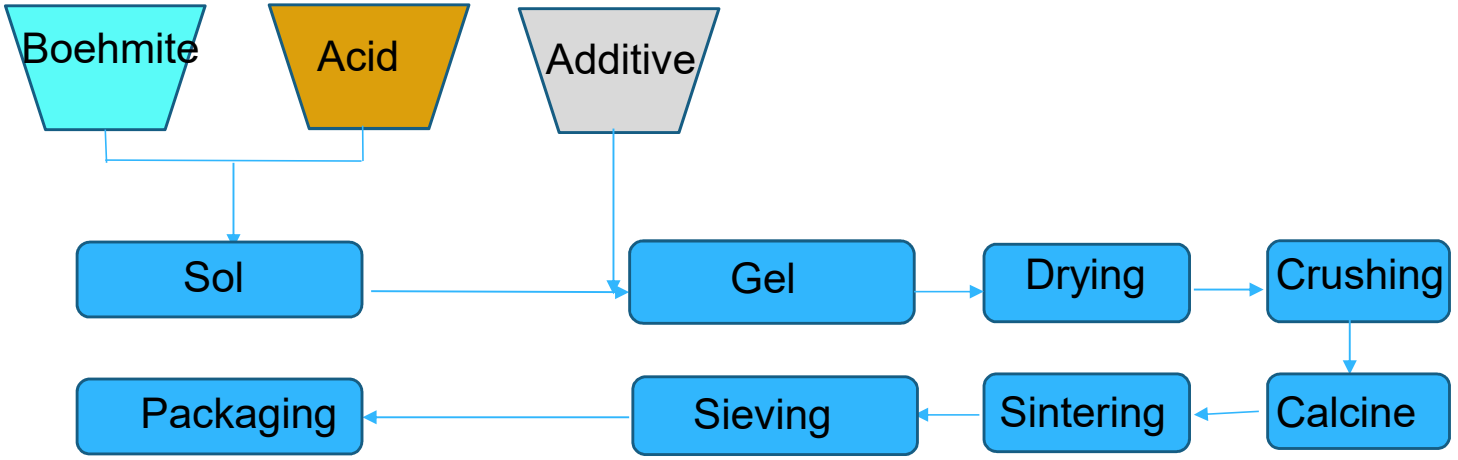
- Composition: Alumina
- Crystalline size: 50~500 nm

Benefit
***Design to nano scale crystalline**
***Controlled shape**

		
Natural shape	Rod shape TG	Triangular flake Cubitron II

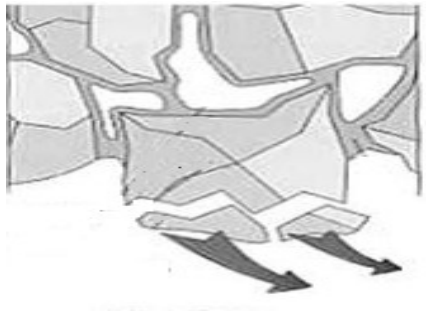
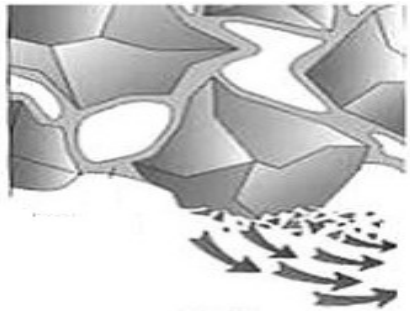
- Process:

Sol-Gel and Sintering Process



Grain crack mechanism and application limitation

Crack Mechanism

	
Conventional grain **Crack at um level**	**Ceramic grain** **Crack at nm level**

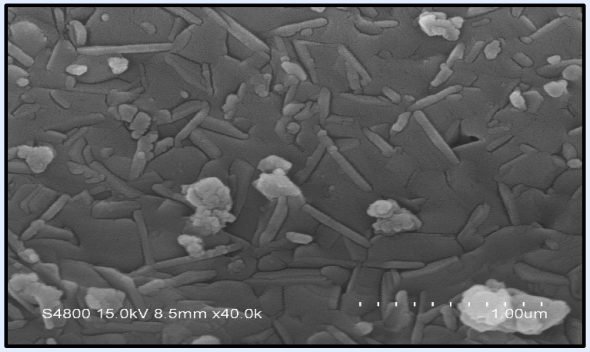
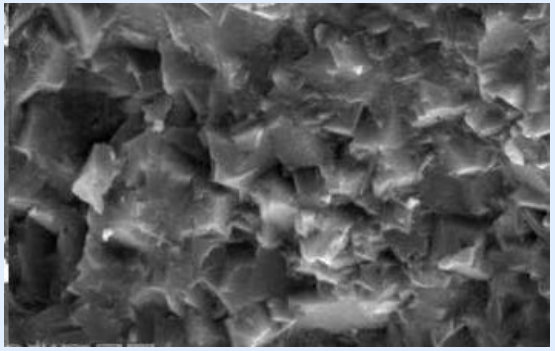
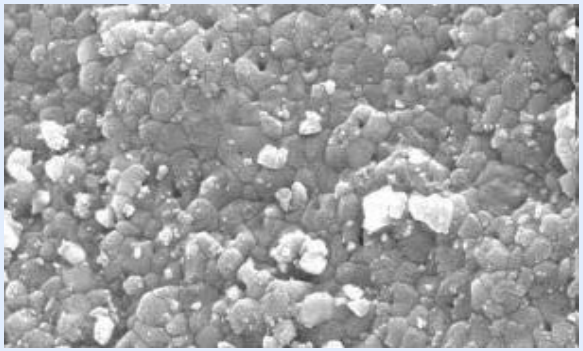
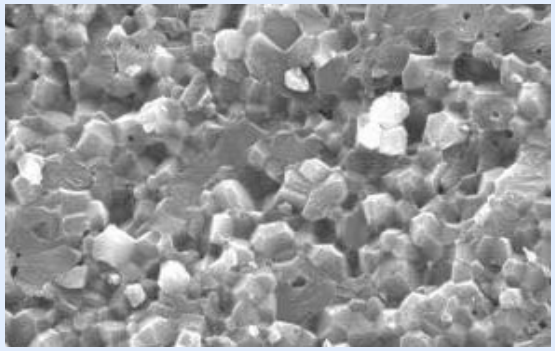
Benefit Point of Ceramic Abrasive

- Nano scale crack create more tiny blade for grinding and longer grain durability.
- Tiny chips reduce the grinding heat concentrate

Application Limitation

- High stiffness of ceramic abrasive need more pressure, and consume more power of machine

Ceramic Abrasive Crystalline design roadmap

Main	SEM on origin surface	SEM on broken surface	Remark
Layer Stack crystalline			◆ 3M create this routine ◆ Needle shape boundary create by RE additive ◆ More sharpness from needle shape boundary ◆ ROY follow this roadmap
Ball Stack crystalline			◆ Saint-Gobain create this routine ◆ More durability due to ball stack structure

*** Remark: blue color is create by Cobalt. No related to grain performance**

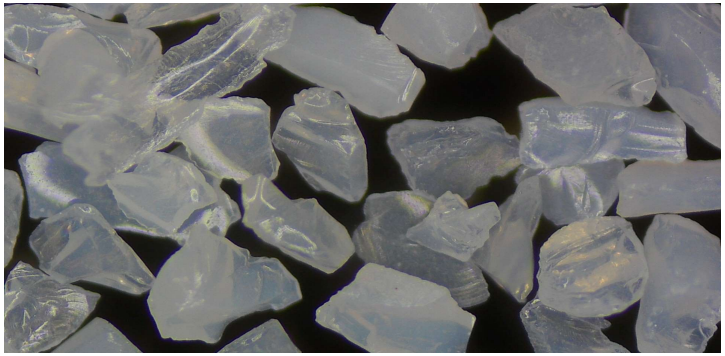
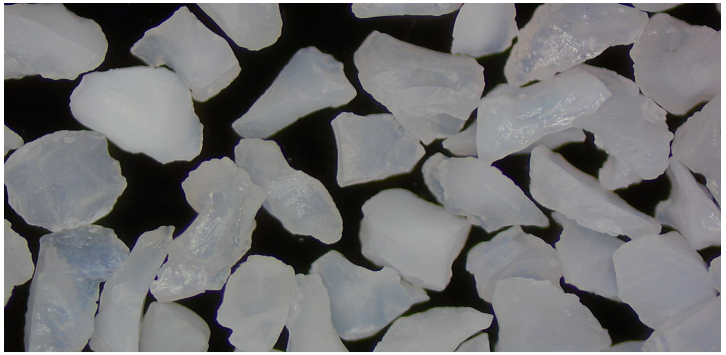
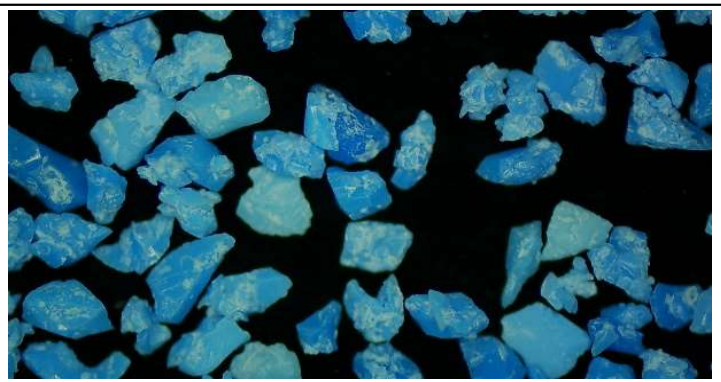
Ceramic Abrasive physical characteristics

Index	Range	Test method	Remarks
True Density	3.85-3.95 g/cm3	Helium density tester	■ Key Characteristics ■ Less than 3.85 means too much porosity within grain， and grain loss basic strength.
Hardness	HV 1600-2200	Micro vickers	■ Reference Characteristics
Crystalline Size	50-500nm	SEM	■ Key Characteristics ■ Smaller size means more easy to crack and more sharpness
Toughness	55-75%	Ball mill method	■ Reference Characteristics ■ Can be used to adjust grinding wheel recipe according application.

Visual inspection of ceramic abrasive performance

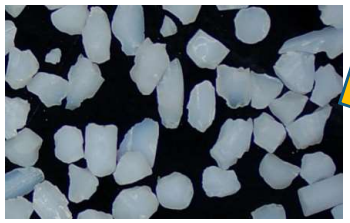
Index	Inspection method	Theory
Transparency	X20 Microscope	● Visible light spectrum(380-780nm) ● More transparency means smaller crystalline ● Bigger grit size will show lower transparency ● Suggest inspection on grit size 80#
Surface status	X20 Microscope	● Rough surface means impurity
Color uniformity	X20 Microscope	● Color uniformity indicate the grain chemical homogeneity.
Color	X20 Microscope	● Light or dark do not related to performance

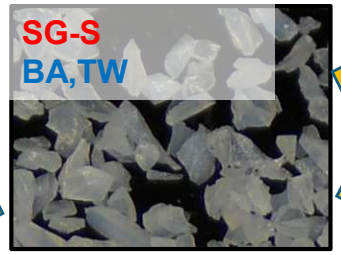
Example of visual inspection

	
Good transparency and smooth surface	Bad transparency and rough surface
	
Good transparency and smooth surface	Bad transparency and bad color uniform Small particle stick on surface

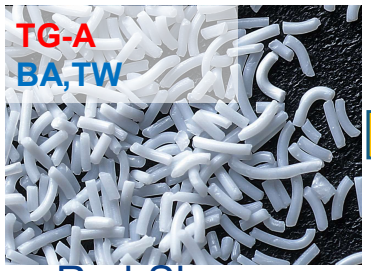
Direction of Ceramic Grain Development

Pointed Shape

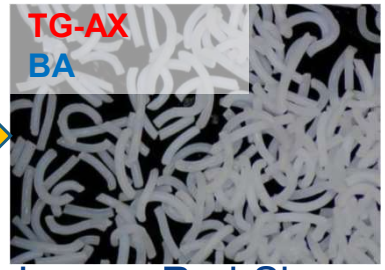

Blocky Shape



Natural Shape



Rod-Shape



Longer Rod-Shape


Triangle

Smaller Crystalline

- **Controlled shape**
- **More sharp in crystalline for better grinding efficiency**

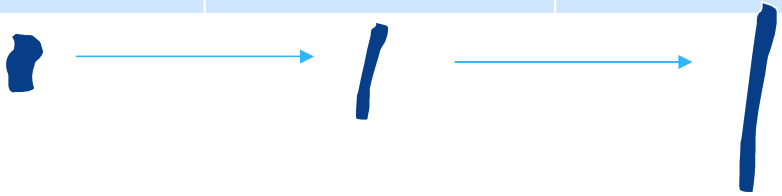
*In RED: Roy Product name

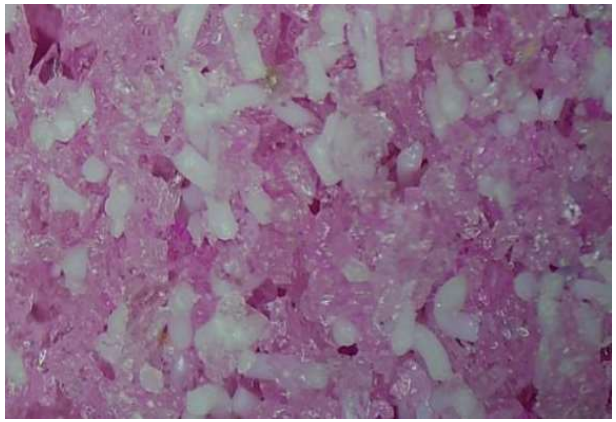
* In Blue: Roy recommend application
  BA: bonded abrasives
  CA: coated abrasives
  TW: cutting disc and depressed wheel

* In Purple: Roy is researching

TG-A Grain Working Mechanism For Bonded Abrasives

Roy Product	SG Natural shape	TG-A	TG-AX
Length: Dia	1：1 to 2：1	3：1 to 6：1	7：1 to 10：1





Market/Application

- **Bearing race grinding**
- **Form Gear Grinding**
- **Worm Gear (M>3)**
- **Bevel Gear Grinding**
- **Creep feed**
  - **Aero/Gas turbine**
  - **linear motion (guide rail grinding)**

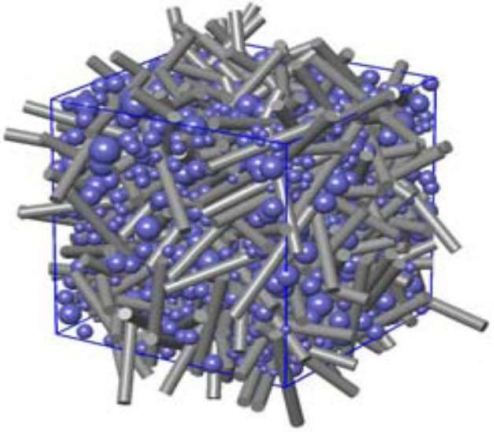
Feature

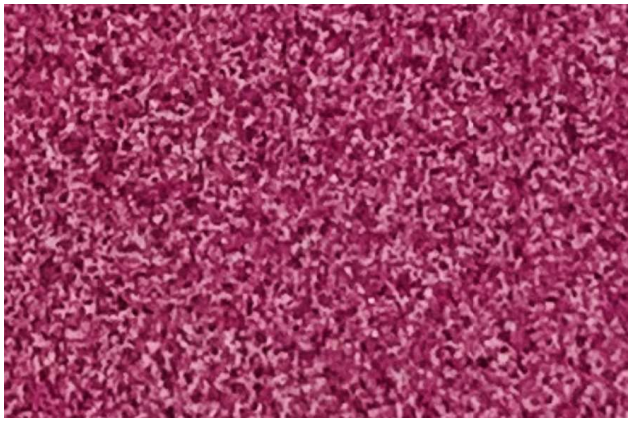
- Longer grain can build wheel with more open structure
- Longer grain can be more firmly hold by binder
- Reduce the pore inducer usage
- 100% TG-AX can build nature open porosity without pore inducer

TG-A Special Value For Bonded Abrasives

Porosity

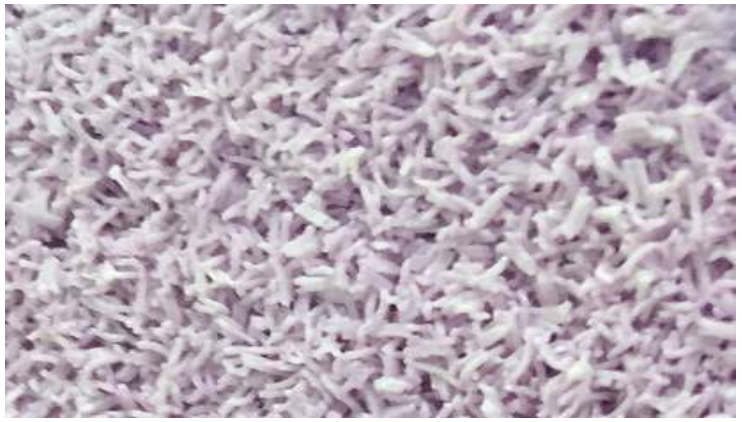
The elongated structure creates an aggressive surface and open structure with high permeability





Wheel Surface
Conventional Grain

VS

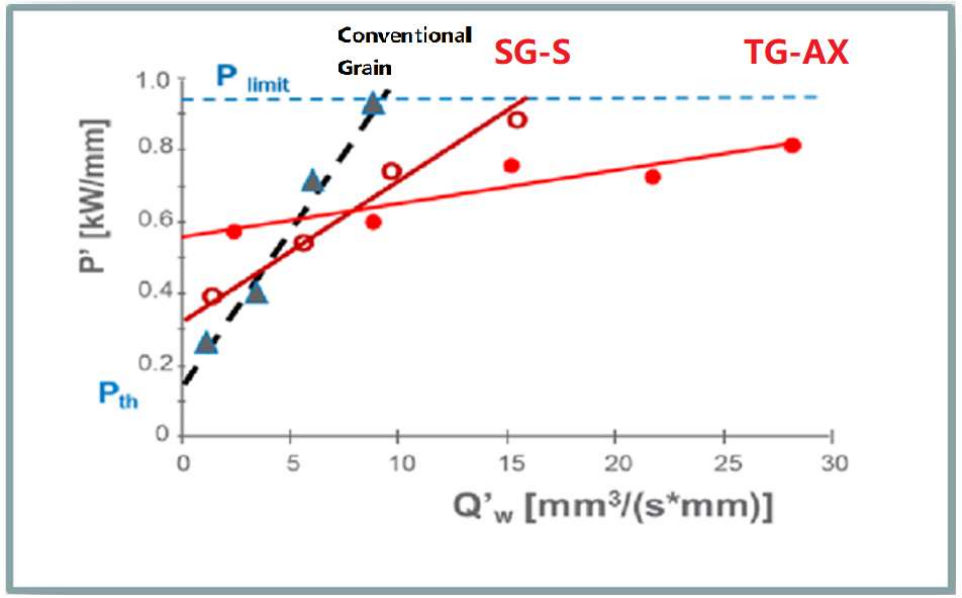


Wheel Surface
TG-AX Grain

TG-A Special Value For Bonded Abrasives

Impact to the grinding process

- **High porosity reduces the interaction between the chips and tool, power increase slowly**
- **Benefit for coolant move in and workpiece chips move out**
- **Extremely high removal rates Q'W reachable**
- **Higher threshold power Pth**

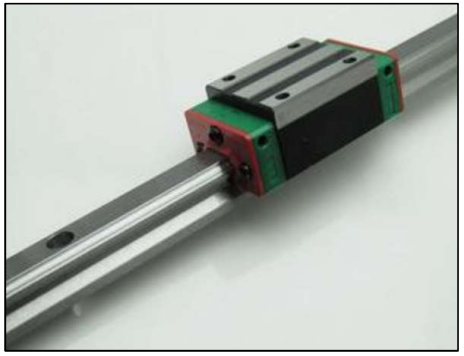


Benefit for application of

1. Big grinding area
2. Close grinding space (easy for heat dissipation)
3. High stock removal

EX: Creep feed

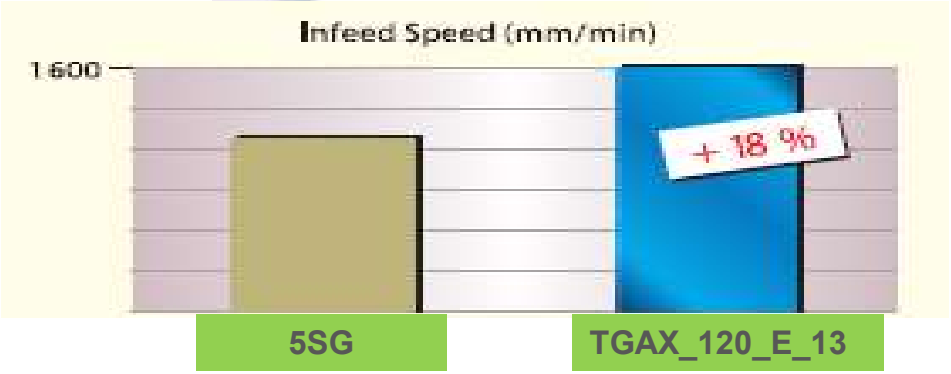
Blade

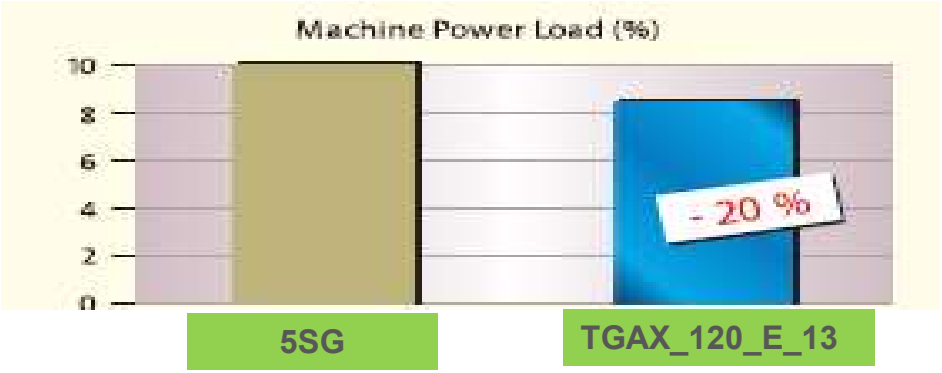


Linear guide rail

Case Study – linear guide rail

Bonded Wheel:	
Spec:	TGAX_120_E_13
Competitor:	5SG
Basic Info:	
Material:	100Cr6-55-60HRC
Workpiece size:	16*4080mm
Wheel Size:	500*16*203.2
Stock Removal:	0.3mm
Dressing:	
Tool:	roller
Wheel speed	14m/s
ratio:	0.8
Dressing depth:	50um/radius





Q&A

Presentation file can be download on
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