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CHARACTERIZATION OF MECHANICALLY ACTIVATED ZIRCONIUM DIBORIDE (ZrB₂) POWDERS

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The Purpose of Study

- ❑ investigate the effect of high energy planetary milling on the powder characteristics of ZrB₂ powders.
- ❑ densify activated powders at low temperatures

Sample	Ball / Powder Ratio (BPR)	Degree of Filling (%)	Milling Time (min)
ZB (sol-gel initial powder)	-	-	-
ZB-1 (sol-gel powder)	47:1	32	8
ZB-2	20:1	40	20
ZB-3	47:1	31	20
ZB-4	50:1	42	20
ZB-5	100:1	33	20

Milling in MPP-1 planetary mill at acceleration 28 G. 0.5 ml of ethanol was added as a process control agent. Steel vial and steel balls with 5 mm diameter . Commercial powders (Alfa Aesar, 99.5 %, -44 μm)

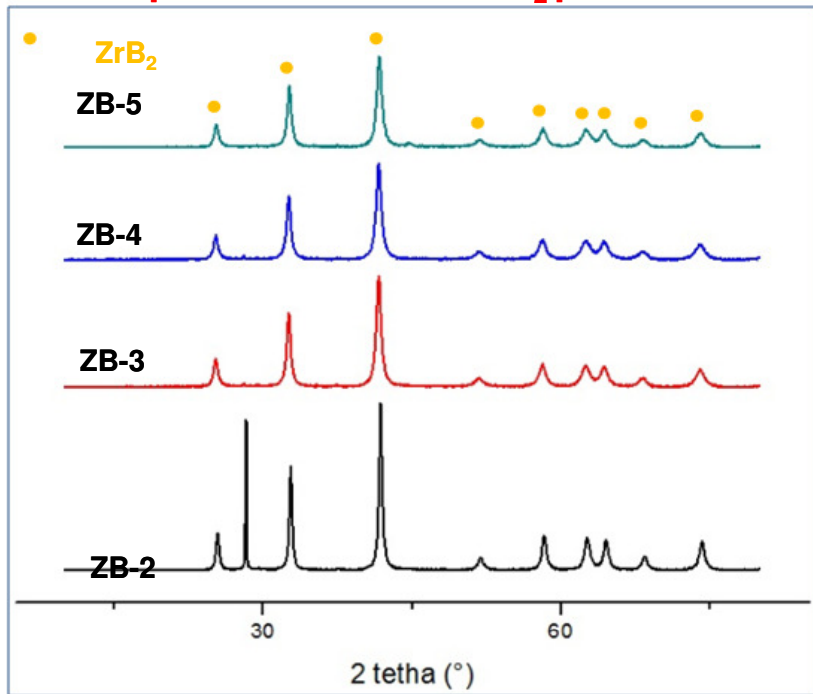
RESULTS 1/2

The Surface area, size and lattice parameters for ZrB₂ powders prepared by mill activation

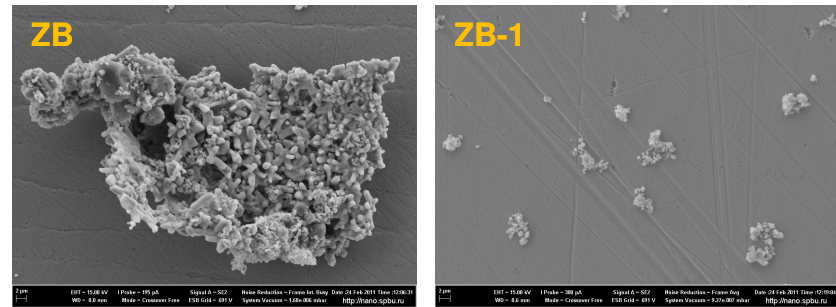
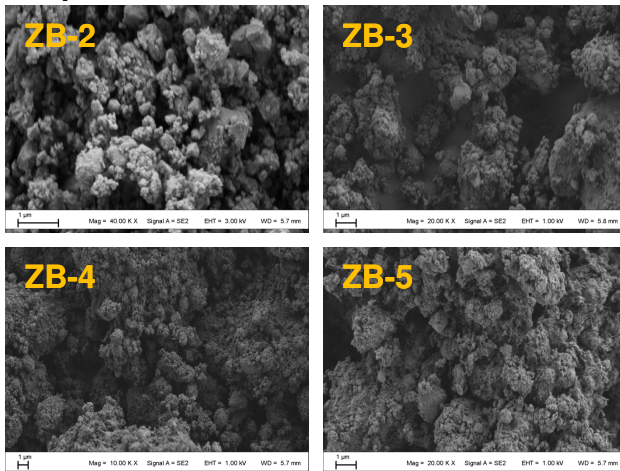
Sample	Surface area (m ² /g)	BET size (nm)	XRD size (nm)	Lattice parameters	
				a	b
ZB	2	492	480	N/A	N/A
ZB-1	4	246	44	N/A	N/A
ZB-2	4.5	220	34.8	3.174812	3.534825
ZB-3	14	70	25.8	3.174656	3.531582
ZB-4	13	76	24.4	3.174815	3.530989
ZB-5	40	25		3.175015	3.531534

RESULTS 2/2

XRD patterns of milled ZrB_2 powders



XRD pattern of sample ZB-2 inhibit contamination of the powder by the milling media. With increasing ball / powder ratio (from ZB-2 to ZB-5), the intensity of peaks are broader and decrease.

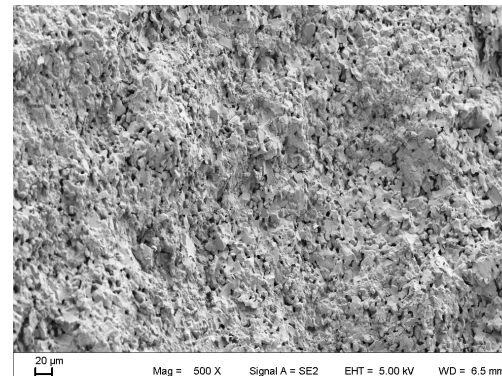


For sol-gel synthesized powders, hard agglomerates were broken and particle size decrease after milling process

Densities of sintered compacts at 1775 °C for 5 h

Sample	Density (%)
ZB-2	88.2
ZB-3	82.1
ZB-4	77.6

Microstructure of compacted ZB-2 powder



CONCLUSIONS

- Parameters of milling allow one to perform fast and efficient particle size reduction.
- Low temperature densification of zirconium diborides can be achieved using high energy ball milling process.
- Mechanical treatment of ZrB₂ in a planetary mill MPP-1 allowed us to obtain powders with average particle size of nanometer scale.
- Colloidal processing methods can be used for preparing agglomeration free-dense sintered compacts