BNFO negative thermal expansion material

– $BiNi_{1-x}Fe_xO_3$ (bismuth · nickel · iron oxide) –

Product Oxide ceramic material showing negative thermal expansion

Application Joining component for dissimilar materials, precision processing component

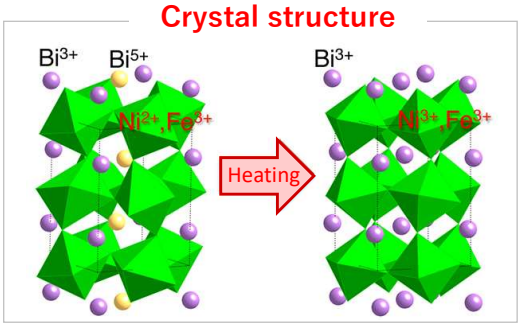
Feature Greater negative thermal expansion (-187 ppm/K)

BACK-GROUND

"BiNi1-xFexO3 (bismuth · nickel · iron oxide)" was developed by team of Masaki Azuma, Tokyo Institute of Technology. JMTC has concluded a joint R&D agreement for this material with the team (Tokyo institute of Technology and Kanagawa Institute of Industrial Science and Technology) and is promoting commercialization.

PRODUCT OVERVIEW

Crystal structure



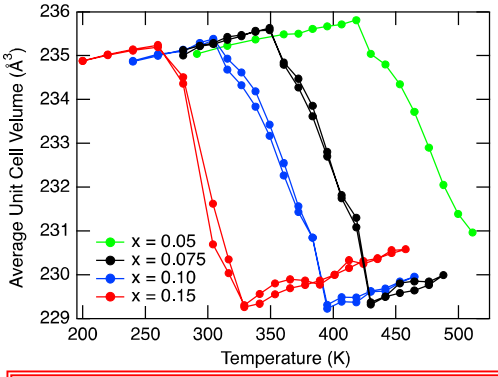
BNFO is oxide ceramic material with a perovskite structure and exhibits a negative linear coefficient of thermal expansion (-187ppm/K). It is expected to use as a filler to reduce CTE (coefficient of thermal expansion) or use as material for sensor.

PRODUCT FEATURE

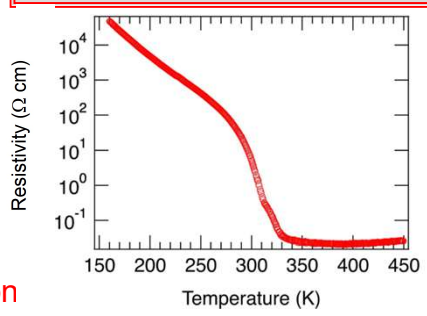
greater negative CTE
Controls thermal expansion in small amount

Product	CTE ppm/K
$LiAlSiO_4$ (β-Eucryptite)	-8
ZrW_2O_8 (Zirconium Tungstate)	-9
Mn-Sn-Zn-N	-40
BNFO	-187
(ref) Epoxy resin	-40

Continuous Shrinkage
3% of volumetric shrinkage, low hysteresis

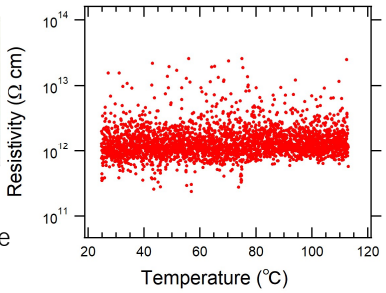


Resistivity change



Compositable

BNFO 18vol %
Epoxy composite



Contact information

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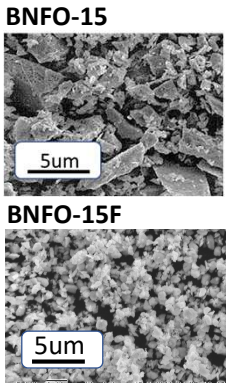
CHARACT-ERISTIC

Hardness	2.5	Gpa
Specific gravity	9.04	
Particle size(D50)	~5um	μm
Resistivity(RT/100°C)	5.04/0.03	Ω cm
Dielectric constant (10MHz)	118	
Loss tangent (10MHz)	1.25	
Specific heat	0.36	J/gK
Thermal conductivity	0.2/1.1	W/Km



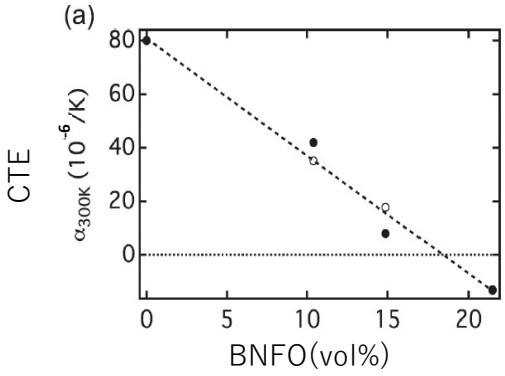
Fine grade is under development

* These values are measured value, not guaranteed

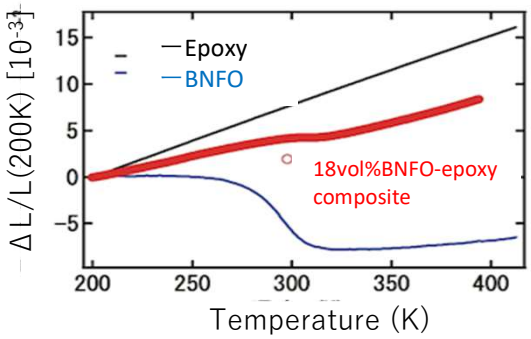
APPLICATION COMPOSITE

It is possible to create a composite of 18 %vol of BNFO in a bisphenol type epoxy resin with a linear thermal expansion coefficient of 80ppm/K.
Zero thermal expansion is achieved in the temperature range of 27 – 57 deg C, the crystalline phase transition temperature.

Thermal expansion at 300K



Thermal expansion of composite



Encapsulants

Low CTE, Improve stress relaxation

By replacing filler such as SiO_2 with BNFO, it could reduce the amount of filler.

Adhesives

Low CTE, Reduce warpage

By using BNFO, it is expected to counteract the high CTE of the resin, resulting in more precise control and less warpage.

APPLICATION SENSOR

The contraction or resistance change at the phase transition temperature of BNFO are reversible reactions and its hysteresis is also small. Sensor applications are also expected.

Pressure sensor

Utilizing contraction and expansion

thermistor

Utilizing resistance change

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