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Theme for Discussion:

Terminology for Compounds in the Si–Al–O–N System

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Abstract

Proposals are made for a nomenclature of sialons. Readers are invited to send comments to the author. The text should be considered as provisional recommendations which may be changed after receipt of comments. © 1997 Elsevier Science Limited.

1 Introduction

Silicon and aluminium containing nitrides and oxynitrides are widely studied by the chemical and ceramic community because of the interesting applications, in particular related to their (thermo-) mechanical properties. In the many publications on these materials several abbreviations are used to designate the materials. These relate in part to the processing technology in part to the composition. Within the ceramic community it is tried to reach agreement upon the use of such acronyms. In the interest of maintaining uniformity in the chemical terms a proposal is made here, supported by the International Union on Pure and Applied Chemistry (IUPAC). This body is responsible for the nomenclature and terminology in chemistry.

In general the use of abbreviations is not encouraged. A general nomenclature on solids is available.[1] In cases where abbreviations are preferred their meaning should always be clearly stated in the text.

2 Terminology

alon	A solid solution in the Al_2O_3–AlN system centred around the composition $5AlN.9Al_2O_3$, with spinel type structure.
SN	Silicon nitride, Si_3N_4. The use of this abbreviation for the compound as such is not encouraged. It can be used in combination with indications for the processing technology.
α-Si_3N_4	A crystalline type of silicon nitride with spacegroup P31*c*.
β-Si_3N_4	A crystalline type of silicon nitride with spacegroup $P6_3/m$ or $P6_3$.
sialon	A generic name for compounds or solid solutions in the system Si–Al–O–N.
α-sialon	A solid solution of composition $M_{m/v}Si_{12-(m+n)}Al_{m+n}O_nN_{16-n}$ with the structure of α-Si_3N_4; here M is an element with valency v, such as Li, Ca, Y and many of the rare earth ions, m and n vary between various limits depending on the element M. Sometimes symbols α and α' are used to indicate α-Si_3N_4 and α-sialon, respectively. Although this can be of use in a phase diagram, the use in texts of α'-sialon instead of α-sialon is not recommended.
β-sialon	A solid solution of composition $Si_{6-z}Al_zO_zN_{8-z}$ with the structure of β-Si_3N_4, where z varies between 0 and about 4.2 (depending on temperature). The use of β'-sialon instead of β-sialon is not recommended and in fact unnecessary since there is a continuous solid solution region starting from β-Si_3N_4.
sialon polytypoids	A series of polytypoids in the sialon system of composition M_mX_{m+1} with M = Al, Si, and X = N, O, where m = 4, 5, 6, 7, 9, 11. They are

layered structures with Ramsdell symbols 8H, 15R, 12H, 21R, 27R, $2H^{\delta}$. Approximate compositions of the main polytypoids are 15R ($SiAl_4O_2N_4$), 12H ($SiAl_5O_2N_5$), 21R ($SiAl_6O_2N_6$), 27R ($SiAl_8O_2N_8$).

In the literature, one finds many abbreviations for compounds in the Si–Al–O–N system. Examples are H, J, K, M, M′, U, W, B and others. Since nowadays the chemical composition and crystal structure are known, the use of such non-self-explaining abbreviations is discouraged. However, exceptions are made for O- and X-phase. These terms are widely used in the solid state chemistry and ceramic communities. Authors should, however, always explain the use of abbreviations in the text.

O-phase A solid solution of composition $Si_{2-z}Al_zO_{1+z}N_{2-z}$, where z varies between 0 and about 0.3.

X-phase A compound in the Si–Al–O–N system with a narrow solubility region. The are several approximate compositions in literature, centred around a composition 53 eq% Al and 75 eq% O.*

As mentioned above, the use of the following abbreviations is discouraged:

M-phase $Ln_2O_3.Si_3N_4$. A melilite type structure with Ln = Y or a lanthanide ion.

M′-phase A solid solution of composition $Ln_2Si_{3-z}Al_zO_3{}_{+z}N_{4-z}$ with z between 0 and 1.

H-phase A solid solution derived from $Ln_{10}Si_6O_{24}N_2$ with apatite type structure.

K-phase A solid solution derived from $Ln_3Si_3O_6N_3$ with wollastonite type structure.

U A solid solution $Ln_3Al_{3+x}Si_{3-x}O_{12+x}N_{2-x}$, with x between 0 and 1, of $La_3Ga_5SiO_{14}$ structure type.

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References

1. Leigh, G. J. (ed.), *Nomenclature of Inorganic Chemistry*. Blackwell Scientific, Oxford, 1990.

Concentrations in compounds with the general formula $Si_aAl_bO_cN_d$ are often given in (charge) equivalent percents. For instance the eq% of Si = $100\times4a/(4a+3b)$, the eq% N = $100\times3d/(2c+3d)$.