

What is claimed is:

# CLAIMS

1. A piezoelectric material comprising:  
AlN doped with cations of one or more elements selected from the group consisting  
5 of:
  - a) one of Sb, Ta, Nb, or Ge;
  - b) Cr in combination with one or more of B, Sc, Y, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, or Yb;
  - c) one of Nb and Ta in combination with one of Li, Mg, Ca, Ni, Co, and Zn;
  - 10 d) Ca in combination with one of Si, Ge, Ti, Zr, and Hf;
  - e) Mg in combination with one of Si, Ge, and Ti; and
  - f) one or more of Co, Sb, Ta, Nb, Si, or Ge in combination with one or more of Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, or Yb;
 the cations at least partially substituting for Al in a crystal structure of the  
15 piezoelectric material.
2. The piezoelectric material of claim 1 having one of the formulas  $\text{Al}_{1-x}\text{Ge}_{3/4x}\square_{1/4x}\text{N}$  or  $\text{Al}_{1-5/3x}\text{Ta}^{5+}_x\square_{2/3x}\text{N}$ ,  $\square$  representing a vacancy in an Al site in the crystal structure of the piezoelectric material.  
20
3. The piezoelectric material of claim 1 having the formula  $\text{Al}_{1-2x}\text{B}_x\text{Cr}_x\text{N}$   $0 < x < 0.15$ .
4. The piezoelectric material of claim 1 having the formula  $\text{Al}_{1-5/3x-3y}\text{Mg}_{2y}\text{Ta}_{x+y}\square_{2/3x}\text{N}$ ,  $\square$  representing a vacancy in an Al site in the crystal structure of the piezoelectric material.  
25
5. The piezoelectric material of claim 1 having the formula  $\text{Al}_{1-2x}\text{Mg}_x\text{Si}_x\text{N}$   $0 < x < 0.15$ .
6. The piezoelectric material of claim 1 having the formula  $\text{Al}_{1-x-y}\text{Cr}^{3+}_x\text{M}^{\text{III}}_y\text{N}$ ,  $\text{M}^{\text{III}} = \text{Sc}^{3+}, \text{Y}^{3+}, \text{Sm}^{3+} \dots \text{Yb}^{3+}, \text{Sm}^{3+} \dots \text{Yb}^{3+} = \text{any one or more of the Lanthanides with atomic}$   
30 numbers from 62-70.
7. The piezoelectric material of claim 1 having a Wurtzite crystal structure.
8. An acoustic wave resonator including the piezoelectric material of claim 1.

9. The acoustic wave resonator of claim 8 configured as a solidly mounted resonator.
10. The acoustic wave resonator of claim 8 configured as a film bulk acoustic resonator.
- 5 11. A filter including the acoustic wave resonator of claim 8.
12. The filter of claim 11 having a passband in the radio frequency band.
- 10 13. An electronic device module including the filter of claim 11.
14. An electronic device including the electronic device module of claim 13.
- 15 15. The electronic device of claim 14 wherein the electronic device module is a radio frequency electronic device module.