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Isotropy of Some Cubic System Alloys

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***Abstract:** The norm of elastic constant tensor and the norms of the irreducible parts of the elastic constants of The alloys Thorium-Carbon, Titanium-Chromium at different percentages of Chromium, Titanium-Niobium at 40% of Niobium, Titanium-Vanadium at different percentages of Vanadium, Tungsten-Rhenium at different percentages of Rhenium, Uranium-Niobium-Zirconium("Mulberry") at 7.5% of niobium plus 2.5% of Zirconium, Vanadium-Chromium at 17.5% of Chromium, Vanadium- Hydrogen at different percentages of Hydrogen, and Vanadium-Oxygen at different percentages of Oxygen are calculated. The relation of the scalar parts norm and the other parts norms and the anisotropy of these alloys are presented. The norm ratios are used to study anisotropy of these alloys.*

***Index Terms** – Thoorium, Titanium, Carbon, Chromium, Vanadium, Uranium, Zirconium, Oxygen, Hydrogen, Niobium, Rhenium, Tungsten, Alloys, Isotropy, Norm, Anisotropy, and Elastic Constants.*

I. INTRODUCTION

The decomposition procedure and the decomposition of elastic constant tensor is given in [1,2,3,4,5,6], also the definition of norm concept and the norm ratios and the relationship between the anisotropy and the norm ratios are given in [3,4,5,6]. As the ratio N_s/N becomes close to one the material becomes more isotropic, and as the ratio N_n/N becomes close to one the material becomes more anisotropic as explained in [3,4,5,6].

II. CALCULATİONS

Table 1, Elastic Constants (GPa), [7]

Alloys, Cubic system at different percentages of - E	c_{11}	c_{44}	c_{12}
Thorium-Carbon ThC0.063	80.2	43.3	50.7
Titanium-Chromium β-Ti-Crat %Cr 6.98	155.9	55.4	82.5
9.36	133.1	42.7	95.1
13.81	139.9	44.2	96.3
28.37	159.1	41.7	94.1
Titanium-Niobium Ti-Nb at % Nb 40	156.5	39.63	111.6
Titanium-Vanadium Ti-V at % V 28	141.1	39.8	103.9
38	148.6	40.8	100.4
53	177.3	41.3	114.7
71	200.8	43.8	111.2
73	192.6	41.6	111.4
79	196.6	41.2	110.4
Tungsten-RheniumW-Re at % Re 2.97	534.7	160.9	216.4
9.64	524.1	168.5	219.1
Uranium-Niobium-Zirconium("Mulberry") U + 7.5 at % Nb + 2.5 at % Zr	134.3	21.33	91.7
Vanadium-Chromium V-Cr at % Cr 17.5	255	44.0	120
Vanadium- Hydrogen V-H at % H 0	230.7	43.0	120.1
0.22	230.6	43.1	120.2
0.62	229.3	43.2	119.9
1.3	228.3	43.3	120.1
Vanadium-Oxygen V-O at% O 0	232.2	44.0	120.4
0.28	233.2	44.1	121.2

By using table1, and the decomposition of the elastic constant tensor, we have calculated the norms and the norm ratios as is shown in table .

Table 2, the norms and norm ratios

Alloys, Cubic system at different percentages of - E	N_s	N_d	N_n	N	$\frac{N_s}{N}$	$\frac{N_d}{N}$	$\frac{N_n}{N}$
Thorium-Carbon ThC0.063	210.139	0	52.333	216.557	0.9704	0	0.2417
Titanium-Chromium β-Ti-Cr at % Cr 6.98	358.101	0	34.278	359.738	0.9955	0	0.0953
9.36	341.558	0	43.443	344.310	0.9920	0	0.1262
13.81	352.444	0	41.060	354.828	0.9933	0	0.1157
28.37	369.483	0	16.864	369.868	0.9990	0	0.0456
Titanium-Niobium Ti-Nb at % Nb 40	394.938	0	31.491	396.192	0.9968	0	0.0795
Titanium-Vanadium Ti-V at % V 28	364.035	0	38.860	366.103	0.9944	0	0.1061
38	367.269	0	30.612	368.542	0.9965	0	0.0831
53	425.099	0	18.330	425.494	0.9991	0	0.0431
71	447.871	0	1.833	447.875	1.0000	0	0.0041
73	437.297	0	1.833	437.301	1.0000	0	0.0042
79	439.988	0	3.4828	440.002	1.0000	0	0.0079
Tungsten-Rhenium W-Re at % Re 2.97	1103.790	0	3.208	1103.800	1.0000	0	0.0029
9.64	1102.300	0	29.328	1102.690	0.9996	0	0.0266
Uranium-Niobium-Zirconium("Mulberry") U + 7.5 at % Nb + 2.5 at % Zr	325.472	0	0.055	325.472	1.0000	0	0.0002
Vanadium-Chromium V-Cr at % Cr 17.5	525.730	0	43.076	527.492	0.9967	0	0.0817
Vanadium-Hydrogen V-H at % H 0	496.997	0	22.546	497.509	0.9990	0	0.0453
0.22	497.113	0	22.18	497.608	0.9990	0	0.0446
0.62	495.165	0	21.080	495.613	0.9991	0	0.0425
1.3	494.405	0	19.797	494.801	0.9992	0	0.0400

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Vanadium-Oxygen V-O at % O 0	499.882	0	21.813	500.358	0.9990	0	0.0436
0.28	502.450	0	21.813	502.923	0.9991	0	0.0434

III. CONCLUSION

We can conclude from table 2 that the most isotropic alloy is Uranium-Niobium-Zirconium ("Mulberry") U + 7.5 at % Nb + 2.5 at % Zr, because it has the highest value $\frac{N_s}{N}$, (1.0000) and the smallest value of $\frac{N_n}{N}$, (0.0002), and also we can conclude that the most anisotropic alloy is the Alloy Thorium-Carbon ThC0.063 because it has the smallest value of $\frac{N_s}{N}$, (0.9704) and the highest value $\frac{N_n}{N}$, (0.2417), and also we can say that in most of the given alloys as the percentage increases the isotropy increases and the anisotropy of the alloy decreases, except in the case of the alloy Titanium-Chromium, β-Ti-Cr as the percentage of Cr increases from 6.98% to 9.36%, the ratio $\frac{N_s}{N}$ decreases from 0.9955 to 0.9920, but as the percentages increases from 9.36% to 13.81% and to 28.37% the ratio $\frac{N_s}{N}$ increases from 0.9920 to 0.9933 and after this to 0.9990, and also in the case of the alloy Tungsten-Rhenium W-Re at % Re as the percentage increases from 2.97% to 9.69% the ratio $\frac{N_s}{N}$ decreases from 1.0000 to 0.9996 , and ratio $\frac{N_n}{N}$, increases from 0.0029 to 0.0266 which means that the alloy becomes more anisotropic. And also by considering the value of N we found that the highest value N (1103.800) is in case of the alloy Tungsten-Rhenium W-Re at 2.97% of Re, and the smallest value of N (216.557), in the case of the alloy Thorium-Carbon ThC0.063 so we can say that the alloy Tungsten-Rhenium W-Re at 2.97% of Re elastically is the strongest, and the alloy Thorium-Carbon ThC0. is elastically least strong.

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