IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Oganesson- An Element With Anomalous Behavior

[1]Dr. Geetu Kuchhal and [2]Dr. Suman Verma

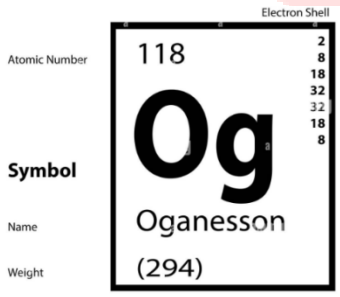
[1]Department of chemistry, South Point degree college, Sonepat,Haryana, Bharat.
[2]Department of Chemistry, South Point degree college, Sonepat,Haryana, Bharat.

Abstract :

The research on the chemical characterization of super heavy elements in the field of radiochemistry is fundamental and intriguing area of research. Understanding these elements can provide valuable information into the structure, properties and behavior of these elements. Transactinides (atomic no >104 are newest members of the periodic table. Recently, the seventh row of the periodic table was completed by the addition of latest addition of last artificial element oganesson (Og, Z =118). In this paper we will discuss the characteristic and properties of this heavy element.

Introduction

Oganesson (symbol Og) is an artificially prepared element with atomic no 118.. it was previously called eka-radonor ununoctium(Uuo). Recently this is officially named by IUPAC. Till now , It is the last entry into the Periodic table completing the seventh period of elements and group 18 of the noble gases. This element is of a "magic" number because it completes the seventh row of the periodic table of elements



Discovery

Oganesson was discovered by Research scientists at the Joint Institute for Nuclear Research in Dubna, Russia and the Lawrence Livermore National Laboratory (LLNL), California. It was produced by the fusion of element -20 with element 98: calcium 48 with californium -249. Calcium ions were formed into a beam in a U400 cyclotron and fired at a target layer of californium oxide deposited on titanium foil.

$^{249}Cf + {}^{48}Ca \rightarrow {}^{294}Og + 3n$, where n stands for neutron

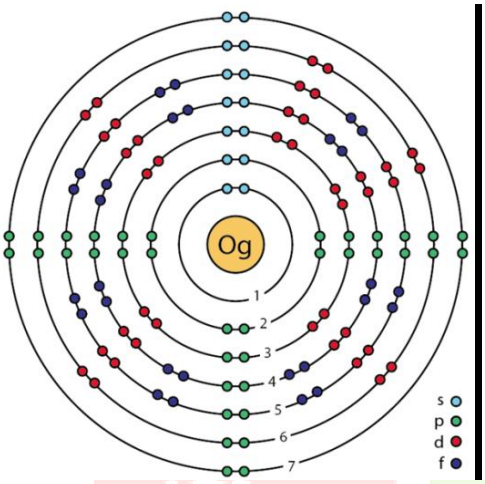
To accumulate a total dose of 2.5 * 10^{19} calcium ions the bombardment lasted for 2300 hrs. two atoms of oganesson –294 was produced in march 2002 which lasted for 2.55ms and 3.16 ms. In 2015 this result was confirmed by IUPAC and discovery was verified.
The element is named after the Russian Professor Yuri Oganessian, for his pioneering contributions to transactinoid elements research.

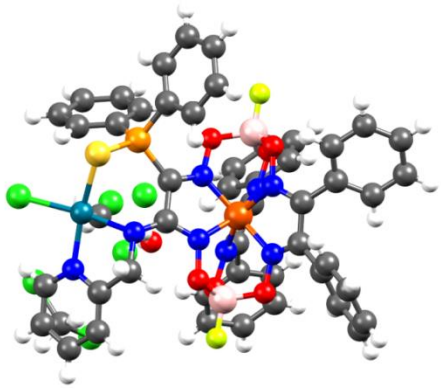
Electronic configuration and structure

Oganesson has a closed shell electronic structure with configuration

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{14} 6d^{10} 7p^6$.

It is regarded as the bottom most member of periodic table and completes the seventh row.





Formula: $C_{48}H_{36}B_2ClF_2FeN_8O_6PPdS$, CH_2Cl_2, 0.5(H2O)

Structure name: span(?-5-(diphenylphosphorothioyl)-1,8-difluoro-11,12,17,18-tetraphenyl-N-((pyridin-2-yl)methyl)-2,7,9,14,15,20-hexaoxa-3,6,10,13,16,19-hexaaza-1,8-diborabicyclo[6.6.6]icosa-3,5,10,12,16,18-hexaen-4-aminato)-chloro-iron(ii)-palladium(ii) dichloromethane.

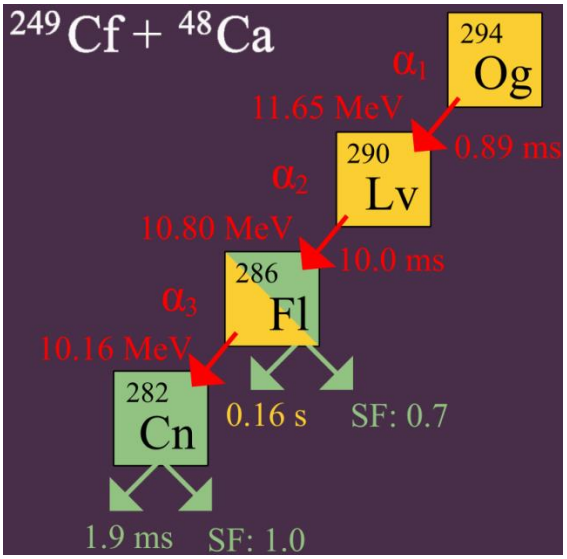
Fun facts: This crystal is one of the only five structures in the database that contain 11 different elements.

Characteristics

- oganesson is a synthetic radioactive element . it is considered as harmful element due to its radioactivity.
- It's density ranges from 5000-5700kg m^{-3} and molar volume is roughly 52cm^3
- Thermal conductivity of this element is 0.0023Wm-1K-1.
- The first ionization energy is 839kJmol-1 and no data is obtained for second and third ionization energy

Alpha decay

During the synthesis , the choice of projectile and target was made so as to get maximum of neutron in the fusion process. Short half life of this element makes it to undergo spontaneous fission of alpha decay to form other superheavy tranactinides such as Lv, Cn and Fl which are relatively long half life.



Fact box

Classification	Nobel gas (nobel solid) and a nonmetal
Atomic weight	294
Electron	118
Proton	118
Neutron	176
Electron shell	2,8,18,32,32,18,8
Electronic configuration	[Rn] $5f^{14}6d^{10}7s^{27}p^{6}$
Melting point	320K
Boiling point	350K
Fusion heat	23.5kJ/mol
Critical point pressure	6.8MPa
Atomic Radius	152 pm
Covalent Radius	157pm
Critical point temperature	439 K
Vaporization heat	19.4kJ/mol

Properties of oganesson

This is being emphasized that chemical and physical properties of the super heavy elements that are strongly influenced by relativistic shell-structure effects leading to anomalies and often unexpected features when comparison is made to their lighter congeners in the periodic table

1. All known isotopes of transactinide elements today mainly feature half-lives in the single-second to sub millisecond regime. At that time, Oganessian and colleagues reported an ^{294}Og half-life of 0.69 ms. Short half life of this element precludes the measurement of its physical and chemical properties.

2. Although it is placed in nobel gas column but it is neither a gas nor noble. So it is a quite unusual noble gas element.
3. All the nobel gas elements are gaseous at room temp. However due to heavy mass and high velocity of the valence electron the oganesson is solid at room temperature.
4. Nobel gases are unreactive due to their full valence electron i.e they can neither gain electron nor loose electron but due to large size Oganesson is comparatively more reactive.
5. Oganesson is predicted to exhibit the variable oxidation states i.e. -1,0,+1,+2,+4,+6
6. Due to large size it has large dipole moment and a positive electron affinity. It also infer that this element should have increased vander waal forces as compared to light noble gas elements.
7. Oganesson is predicted to have boiling point between 320K and 380K which helps to infer that it is a liquid at room temperature in contrast to other noble gases.
8. Computer modeling shows that more stable isotopes of oganesson may have atomic masses as high as 313.

9. It is being observed that noble gases are insulator as electronic gaps ranging from 21.51eV to 9.32eV . however the electronic structure of oganesson suggests that it is a metallic semiconductor and electronic gap is around 1.5eV.
10. Rarely, and only recently, half-lives in the range of up to minutes and even hours were observed among the α-decay products of the heaviest SHEs leading to neutron-rich radioisotopes of lighter transactinides.
11. An unusual atomic feature of Og is its electron affinity, which is predicted to be positive in contrast to its lighter homologs.

Applications

- Oganesson nanorods are more appropriate option for using in optothermal human cancer cells, tissues and tumors treatment method.

- Thermoplasmonic characteristics of Oganesson nanoparticles with spherical, core-shell and rod shapes are investigated

Conclusion

The aim of this paper is to analyse of the basic atomic properties and chemical properties of Og obtained on the present highest possible level of theory.This thrilling and stimulating research topic not only offers exciting prospects for young researchers in nuclear sciences and engineering, but also relies on the international collaboration of research institutions across the globe.

Reference

1) T. Oganessian *et al.* Synthesis of the Isotopes of Elements 118 and 116 in the ^{249}Cf and ^{245}Cm + ^{48}Ca Fusion ReactionsPhys. Rev. C
2) P.J. Karol *et al.* Discovery of the Element With Atomic Number Z = 118 Completing the 7th Row of the Periodic Table (IUPAC Technical Report)
3) V. Pershina Relativity in the Electronic Structure of the Heaviest Elements and Its Influence on Periodicities in Properties
4) O.R. Smits *et al.*Oganesson: A Noble Gas Element That Is Neither Noble Nor a Gas Angew. Chem. Int. Ed.
5) J.M. Mewes *et al.* Oganesson Is a Semiconductor: On the Relativistic Band-Gap Narrowing in the Heaviest Noble-Gas Solids
6) E. Eliav *et al.* Element 118: The First Rare Gas with an Electron Affinity Phys. Rev. Lett.
7) C.S. Nash Atomic and Molecular Properties of Elements 112, 114, and 118 J. Phys. Chem. A
8) Dyall, K.G. and Fægri, K., Jr. (2007) Introduction to relativistic quantum chemistry. Oxford University Press, Oxford.
9) Powell, R.E. (1968) J. Chem. Educ., 45, 558–563.
10) Pyykkö, P. (2012) Chem. Rev., 112, 371–384.
11) Rose, S.J., Grant, I.P. and Pyper, N.C. (1978) J. Phys. B, 11, 1171–1176.
12) 22. Pyykkö, P. and Desclaux, J.-P. (1979) Acc. Chem. Res., 12, 276–281 B. Eichler, Kernenergie 1976, 19, 307; b) B. Eichler, T. Reetz, Kernenergie 1982, 25, 218
13) V. Pershina, Inorg. Chem. 2018, 57, 3948,
14) B. Eichler, H. Rossbach, Radiochim. Acta 1983, 33, 121,
15) Dyall, K.G. and Fægri, K., Jr. (2007) Introduction to relativistic quantum chemistry. Oxford University Press, Oxford.
16) Powell, R.E. (1968) J. Chem. Educ., 45, 558–563.
17) Pyykkö, P. (2012) Chem. Rev., 112, 371–384.
18) Rose, S.J., Grant, I.P. and Pyper, N.C. (1978) J. Phys. B, 11, 1171–1176.
19) Pyykkö, P. and Desclaux, J.-P. (1979) Acc. Chem. Res., 12, 276–281
20) Dyall, K.G. and Fægri, K., Jr. (2007) Introduction to relativistic quantum chemistry. Oxford
21) University Press, Oxford.
22) Abbott, B P, et al. (2017), "Multi-messenger observations of a binary neutron star merger," Astrophys. J. Lett. 848, L12, 1710.05833.
23) Abusara, H, A. V. Afanasjev, and P. Ring (2012), "Fission barriers in covariant density functional theory: Extrapolation to superheavy nuclei," Phys. Rev. C 85, 024314.
24) Ackermann, D (2015), "Nuclear spectroscopy in nuclei with Z > 110," Nucl. Phys. A 944, 376 – 387.
25) J.M.L. Martin Ab Initio Total Atomization Energies of Small Molecules–Towards the Basis Set Limit Chem. Phys. Lett.
26) J. Blomqvist Vacuum Polarization in Exotic Atoms Nucl. Phys. B