

Creating attraction between molecules deep in the periodic table

January 22 2019

pe 1 294 220 1 rogène 1 035 3 1 1000 8076 11 8	2 9.012182 Bee Bégylinn 1230 24.3050 24.3050 24.3050 12 Mg	our multer de masue te plus addé 1° énergie d'ionisation Symbole chimique Febr Nom Fer Configuration électronique [Ar] 3d ⁶ 4s ²					éro atomique ronégativité de Pauling d'oxydation 15 les plus courant gras.	Métaux Métaux Autes Métaux Lantha Actinid	alcalins 5-terreux métaux de transition nides les	Métalloi Non-mé Halogèr Gaz noł Élémen ¥ Élément	des taux tes oles ts inconnus s radioactifs	13 10,811 5 B B B C C C C C C C C C C C C C	14 12:0107 10:853 2:35 6 C Carbone 10:32:32 ⁴⁵ 28:08:35 28:08:35 28:08:35 28:08:35 28:08:35 28:08:35 28:08:35 28:08:35 28:08:35 28:08 10:39 ⁴ 28:09 28:08 29:09 10:39 ⁴ 28:09 10:39 ⁴ 28:09 11:39 ⁴ 29:09 11:39 ⁴ 29:09 11:39 ⁴ 29:09 11:39 ⁴ 20:09 11:39 ⁴ 20:09 11:39	15 14:0067 1903 1003	16 15.9994 8 O yeine 10' 30' 30' 32.005 2.08 32.005 16 S	17 18.998403 9 F F Elisor 10 20 3/20 17 35.453 35.453 35.453 10 17 Cl 15 17 17 17 17 17 17 17 17 17 17 17 17 17	18 4.002602 27231 He 14clium 10 20.1797 11 Sass Ne Néon 10.2624 29.948 1 Ar
um)83 19	Magnésium Nej 34 ³ 40,078 20	3 44,95591 21	4 47.867 2.2	5 50,9415 23	6 51,9962 24	7 54,93804 25	55,845 26	9 58,93319 27	10 58,6934 28	11 63,546 29	12 65,38 30	Aluminium (Ne) 34 344 69,723 31	Silicium Nel 162 Tpe 72,64 32	Phosphore 1 Nel 36 3p ³ 3 74,92160 33	Soufre Ne 36 36 2 78,96 34	Chlore :4 Nel 34 3pt 1	Argon Nei 34 34 83,798 2
ssium ¹⁷⁸ 37 b	Ca Calcium (A) 60 ST Strontium	Scandium 105 34 60 88,90585 39 Yitrium	$\begin{array}{c} & \underset{[1,3]{(3,3]}{\text{magenta}} \\ = & \underset{[1,3]{(3,3]}{magenta$	Vanadium 10:30° 60° 92,90638 41 Niobium	Chrome 1 0,0136 60' 21 0,0136 60' 21 0,0106 60' 21 0,0106 60' 21 0,0106 60' 21 0,0106 60'	^{717,3} 1,33 2,57 Mn Manganèse ^{10,130,60} 98 2,50 43 Tc Technétium	Fee 1,81 20 5 Fee 1,81 20 5 Fee 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	200.3 1.01 27 Cobalt 102.9055 45 Rhh Rhedium	$\begin{array}{c} \sum_{\substack{1 \le i \le 2 \le 0 \\ \text{Nickel} \\ (i) \le i \le 6}} \sum_{\substack{1 \le i \le 2 \le 0 \\ \text{Nickel} \\ 106, 42 \\ \text{sol} 4 \\ 2:20 \\ \text{Pdd} \\ \text{Palladium} \end{array}$	$\begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \begin{array}{c} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \begin{array}{c} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \begin{array}{c} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \begin{array}{c} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \begin{array}{c} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \begin{array}{c} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \begin{array}{c} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \begin{array}{c} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \begin{array}{c} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \begin{array}{c} \\ \\ \end{array} \\ \end{array} \\ \begin{array} \\ \end{array} \\ \end{array}$	$\begin{array}{c} \sum\limits_{\substack{0 \leq i \\ X^{1} \leq i \leq n \\ X^{1} \leq i \leq n \\ S \leq S}} \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum \sum \sum \sum \sum\limits_{\substack{1 \leq i \leq n \\ S \leq S}} \sum i \sum i S \sum \sum \sum \sum$	$\frac{Gallium}{I4,818} 49$	Cermanium Ge 118.710 7000 1.56 50 Sn Étain	Arsenic Arsenic Arster 60 fp 121,760 51 \$50 200 51 \$50 30 Antimoine		$\frac{Br}{Brome}_{\frac{1}{2},50\%}$	Krypton Aride 4:40 131,293 120,4 2,60 Xénon
8054 55 959 55 S	137,327 3029 0.80 56 Bayum	174,9668 71 Lutécium	178,49 178,49 1985 1.30 1997 1.30 10	180,9478 73 180,9478 73 Ta Tantale	183,84 700 2.36 W	186,207 7000 1.00 75, Ree Bhénium	190,23 8600 2.20 Osmium	192,217 192,217 192,217 192,217 192,217 192,217 192,217 192,217	195,084 195,084 800 2,28 Platine No 60 5 Plat	196,9663 79 Au	200,59 100,1 2,00 Hgg Mercure	104 40° 50° 50° 204,3833 81 Thallium Ye 50° 50° 60° 60°	207.2 207.2 205.2 20	208,9804 83 Bismuth bismuth	210 9 84 R12.1 2.00 84 PO 200 22 Polonium No 95 515 62 62	Astate	Re de Solge 220 2 8 Ran Radon
°.,, 87 r	226 * 88 2003 0.00 88 Radium Bot 50	262 * 103 Data Lawrencium Bac 311 74 741	261 * 104 3000 · 1 Rutherfordium Ret 2* 647 54	262 * 105 Db Dubnium	266 * 106 Sg Scaborgium	264 * 107 Bh Bohrium	²⁷⁷ * 108 Hs. Hassium	268 😤 109 Mt Meitnerium	²⁷¹ * 110 Ds Darmstadium	272 ¥ 111 Rg Roentgenium	²⁸⁵ 285 112 Cn Copernicium	²⁸⁴ * 113 Uut ^{Ununtrium}	²⁸⁹ ¥ 114 Fl ^{Flérovium}	²⁸⁸ ¥ 115 Uup	²⁹² * 116 LV Livermorium	117 Uus ^{Ununseptium}	²⁹⁴ * 11: Uuo ^{Ununoctium}
$ \begin{array}{c} \\ \hline \\ $													70 3 ,102 ,102				

A McGill-led international research team provides the first experimental and theoretical proof that it is possible to form strong, stable attractions between some of the heavier elements in the periodic table—such as arsenic or even antimony. Because hydrogen is not involved in creating the bond between these elements, these new materials should be resistant

Credit: CC0 Public Domain



to water and humidity.

Imagine a waterproof computer. It's not going to happen tomorrow, but it may no longer be a pipedream since a McGill-led international research team has shown for the first time that it is possible to form strong, stable attractions between some of the heavier elements in the periodic table. A recent article in *Nature Communications* provides the first experimental and theoretical proof that heavy, large atoms of an increasingly metallic nature—such as arsenic or even antimony—can be used to create <u>new materials</u> called cocrystals by using halogen bonds. Because hydrogen is not involved in creating the <u>bond</u> between these elements, these new materials should be resistant to water and humidity.

Creating cocrystals from deep in the periodic table

Much of recent research in chemistry has focused on creating new materials by manipulating the way that molecules recognize one another and come together to build more complex, self-organized structures. For example, cocrystals based on either hydrogen or halogen bonds have been extensively used by scientists in the design and manufacture of new improved pharmaceuticals, polymers with enhanced properties such as Kevlar, and more recently, <u>materials</u> for use in electronics. Until recently, such interactions invariably had to include at least one atom of a 'lighter' <u>element</u> found at the very top of the periodic table, such as hydrogen, nitrogen, oxygen, fluorine etc.

"Quite apart from the potentially practical applications of this discovery, it is a big advance in fundamental chemistry," says McGill chemistry Professor Tomislav Frišči?, one of the senior authors on the paper. "For the first time researchers have demonstrated molecular recognition events including only <u>heavier elements</u> located in the 4th and 5th periods. This is significantly deeper in the periodic table than has been seen until now. It is a very exciting time to be a chemist—it's as though



we were explorers moving closer to the South Pole of the <u>periodic table</u> —and who knows what we will find there."

The research grew out of a collaboration between scientists from Canada, Croatia and the UK who continue to work in the area. Their next goal is to include bismuth, the heaviest element that can be considered stable, in this type of material design.

According to Frišči, that would really be going to the very tip of the South Pole.

More information: Katarina Lisac et al, Halogen-bonded cocrystallization with phosphorus, arsenic and antimony acceptors, *Nature Communications* (2018). DOI: 10.1038/s41467-018-07957-6

Provided by McGill University

Citation: Creating attraction between molecules deep in the periodic table (2019, January 22) retrieved 2 May 2024 from <u>https://phys.org/news/2019-01-molecules-deep-periodic-table.html</u>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.