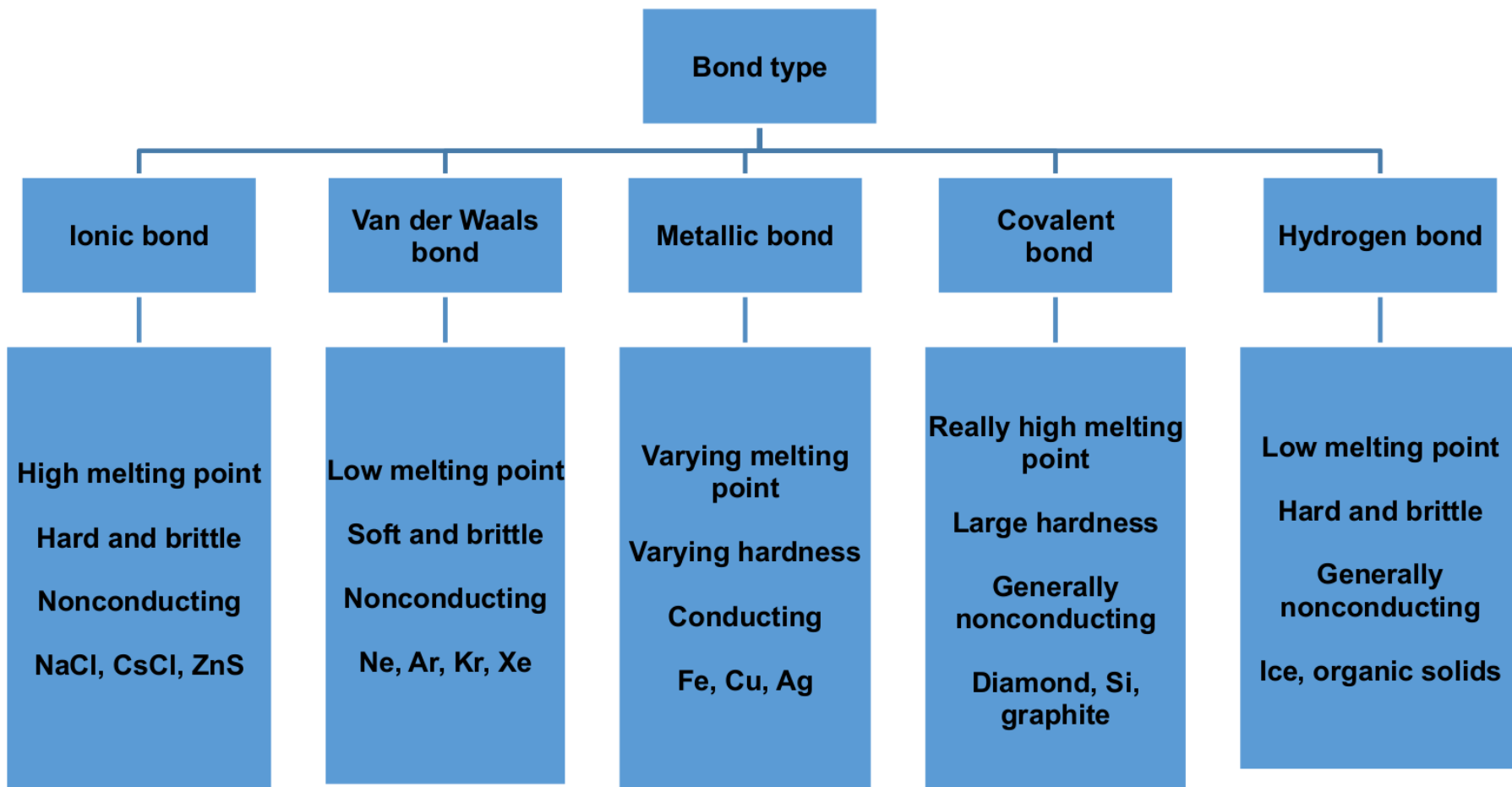


Φ – 575 Διάλεξη 01

Φυσική διατάξεων δισδιάστατων ημιαγωγών

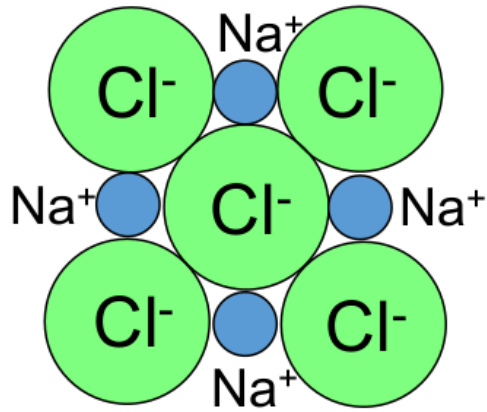
Γιώργος Δεληγεώργης (deligeo@physics.uoc.gr)



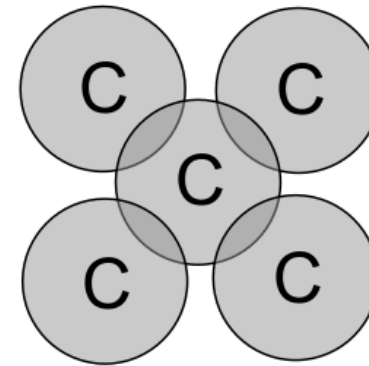


Ιοντικός δεσμός: Ηλεκτρόνια μεταφέρονται από το ένα άτομο στο άλλο

Ομοιοπολικός δεσμός: Ηλεκτρόνια διαμοιράζονται μεταξύ ατόμων σε γειτονία



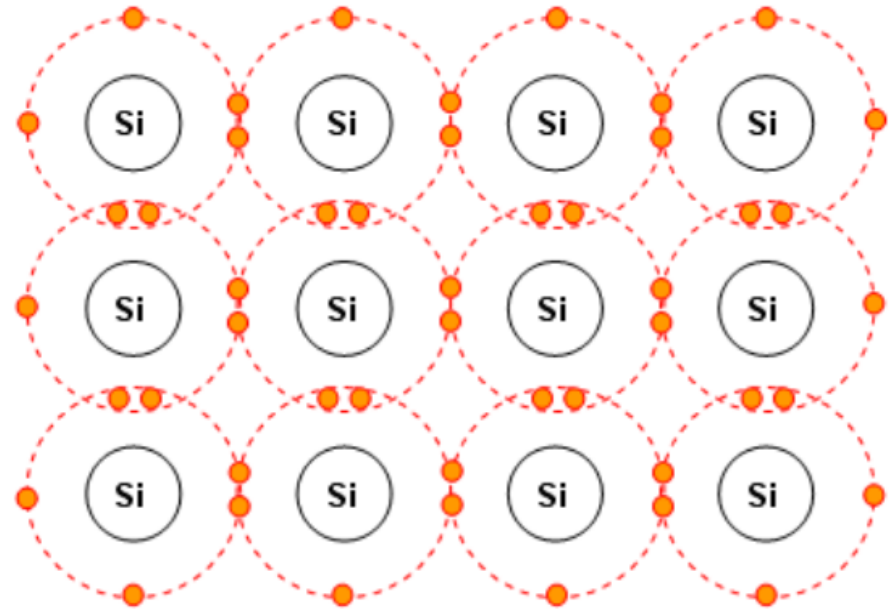
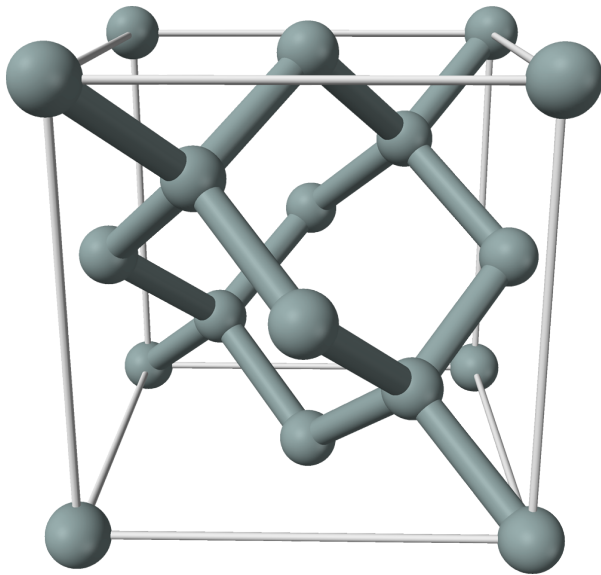
Sodium chloride (ionic)



Diamond (covalent)

Ηλεκτρονιακή δομή Si: $1s^2 2s^2 2p^6 3s^2 3p^2$

4 ηλεκτρόνια ζώνη σθένους, 4 ηλεκτρόνια λείπουν για να συμπληρωθεί η στοιβάδα



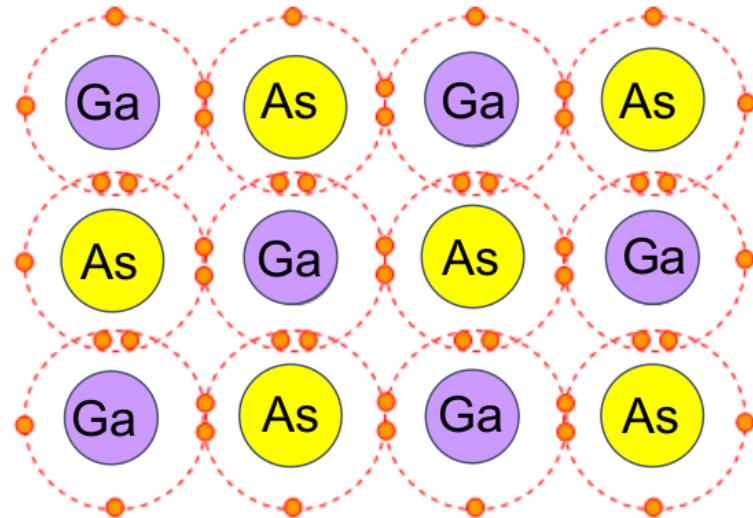
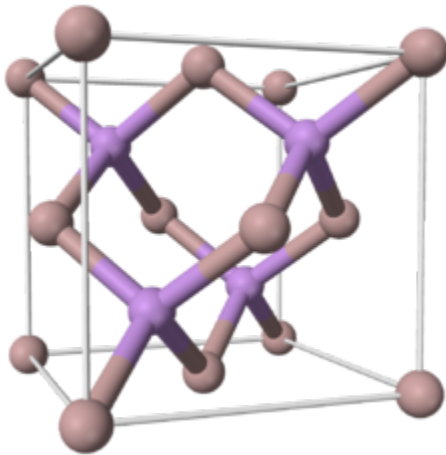
Τι δεσμός είναι αυτός?

Ηλεκτρονιακή δομή Ga: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^1$

3 ηλεκτρόνια ζώνη σθένους, 5 ηλεκτρόνια λείπουν για να συμπληρωθεί η στοιβάδα

Ηλεκτρονιακή δομή As: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^3$

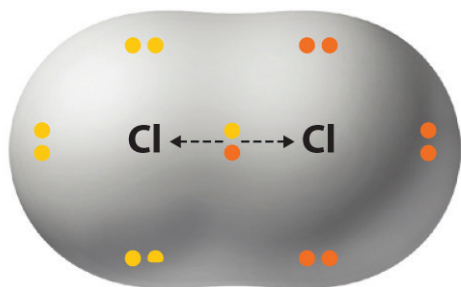
5 ηλεκτρόνια ζώνη σθένους, 3 ηλεκτρόνια λείπουν για να συμπληρωθεί η στοιβάδα



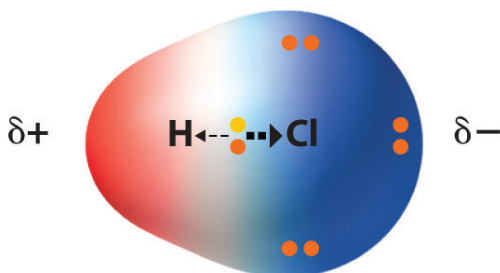
Τι δεσμός είναι αυτός?

Ομοιοπολικός δεσμός υπάρχει μόνο μεταξύ όμοιων ατόμων.

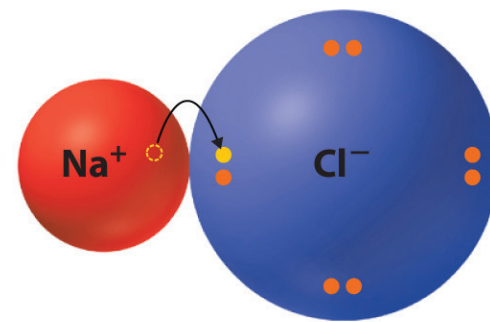
Μεταξύ ανόμοιων ατόμων υπάρχει κάποιος βαθμός πολικότητας (ιοντικός χαρακτήρας)



Nonpolar covalent bond



Polar covalent bond



Ionic bond

In two dimensions there are (besides identity): **mirror**, rotation, and glide

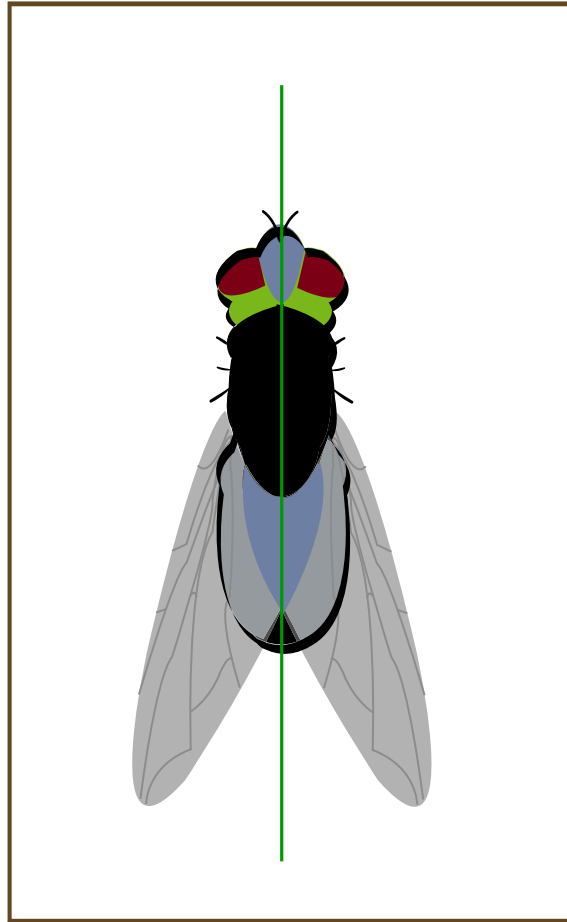


Figure by MIT OpenCourseWare.

In two dimensions there are (besides identity): mirror, **rotation**, and glide

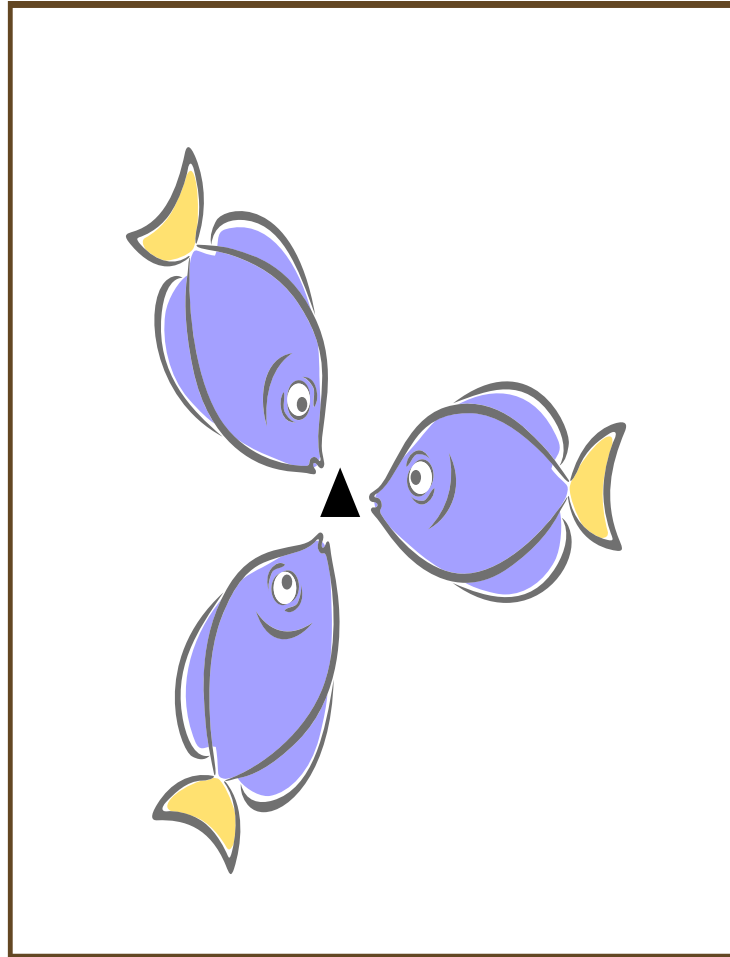


Figure by MIT OpenCourseWare.

In two dimensions there are (besides identity): mirror, rotation, and **glide**

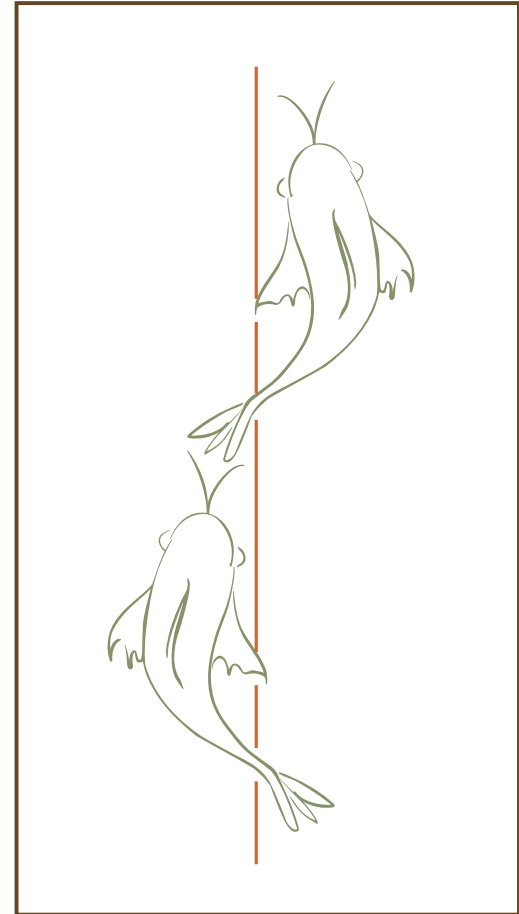
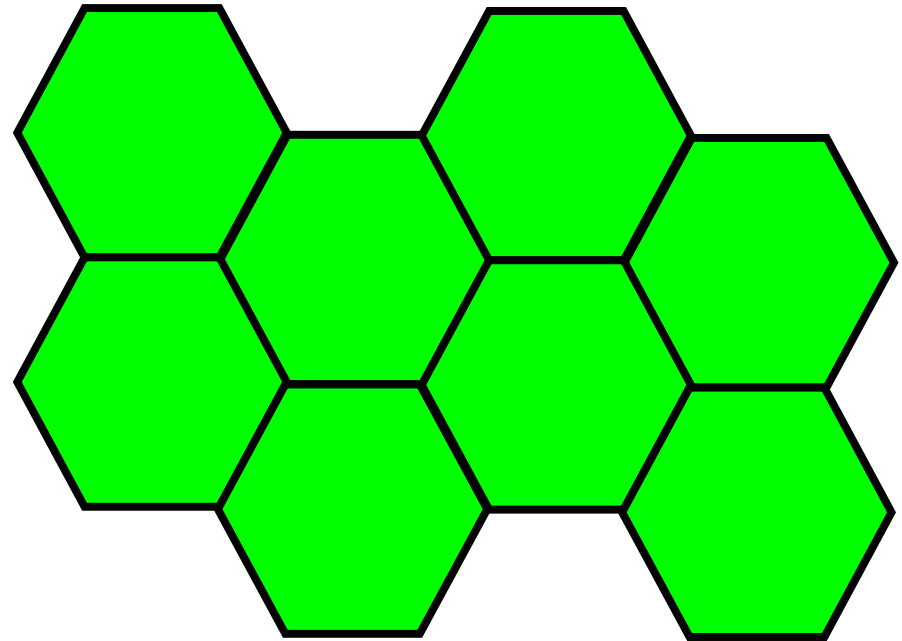


Figure by MIT OpenCourseWare.

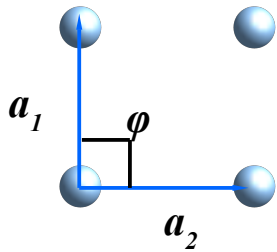
Some symmetry operations are compatible with translation, some are not.

Compatible are:

- mirror
- glide
- twofold rotation
- threefold rotation
- fourfold rotation
- sixfold rotation



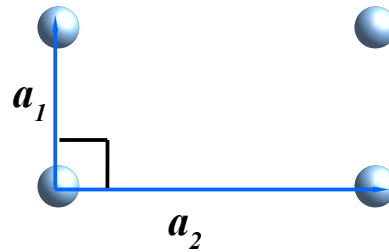
Square lattice



$$|a_1| = |a_2|$$

$$\varphi = 90^\circ$$

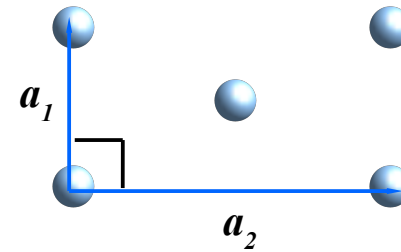
Rectangular lattice



$$|a_1| \neq |a_2|$$

$$\varphi = 90^\circ$$

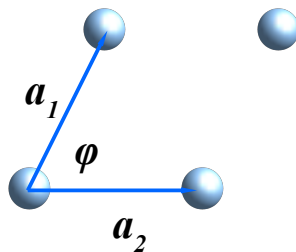
Centered rectangular lattice



$$|a_1| \neq |a_2|$$

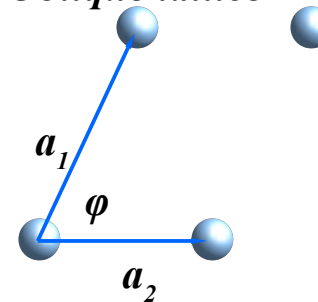
$$\varphi = 90^\circ$$

Hexagonal lattice



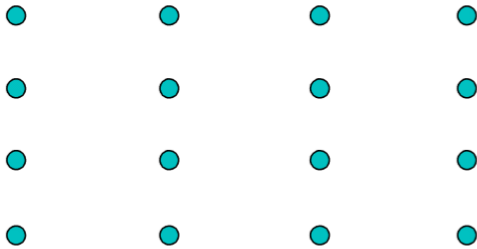
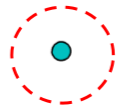
$$|a_1| = |a_2| \quad \varphi = 60^\circ$$

Oblique lattice

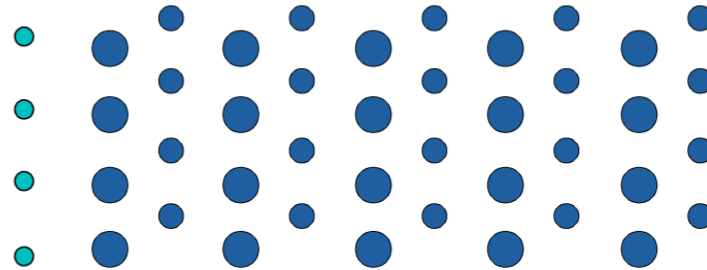
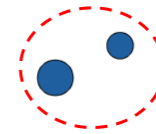


$$|a_1| \neq |a_2|$$

One atom basis

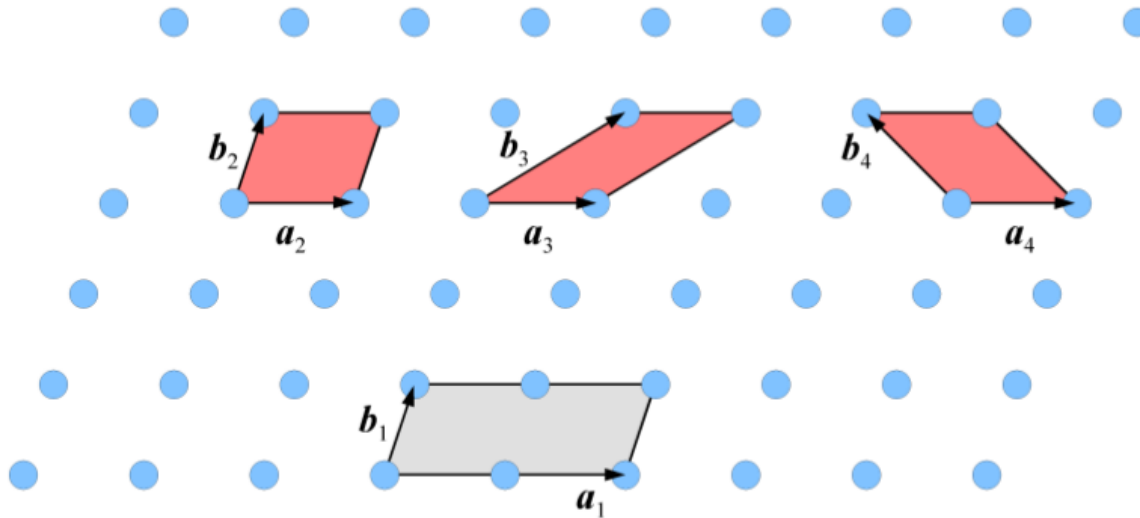


Two atom basis



*Η βάση του κρυστάλλου
αποτελείτε από ένα άτομο*

*Η βάση του κρυστάλλου
αποτελείτε από δύο άτομα (εδώ
ανομοια)*

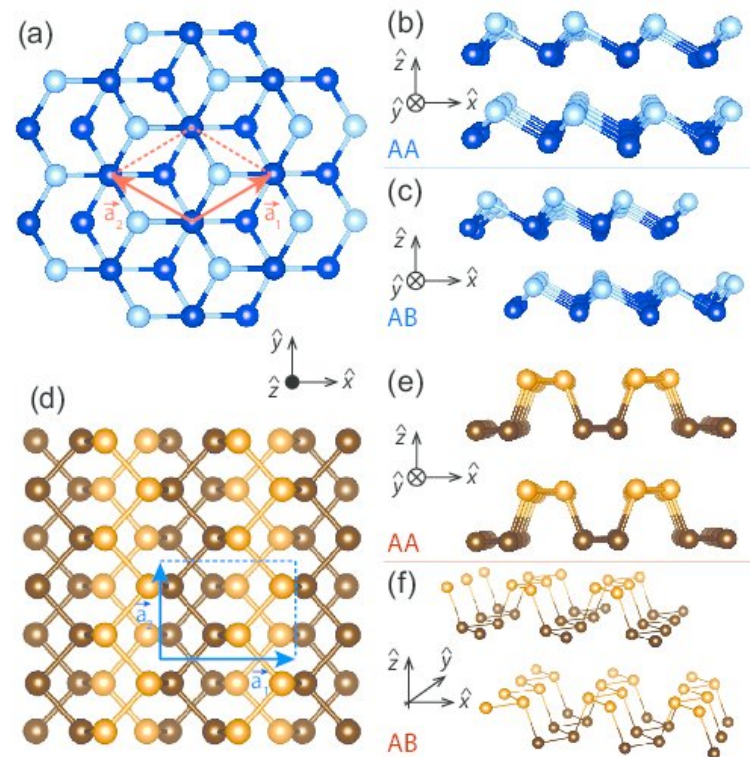
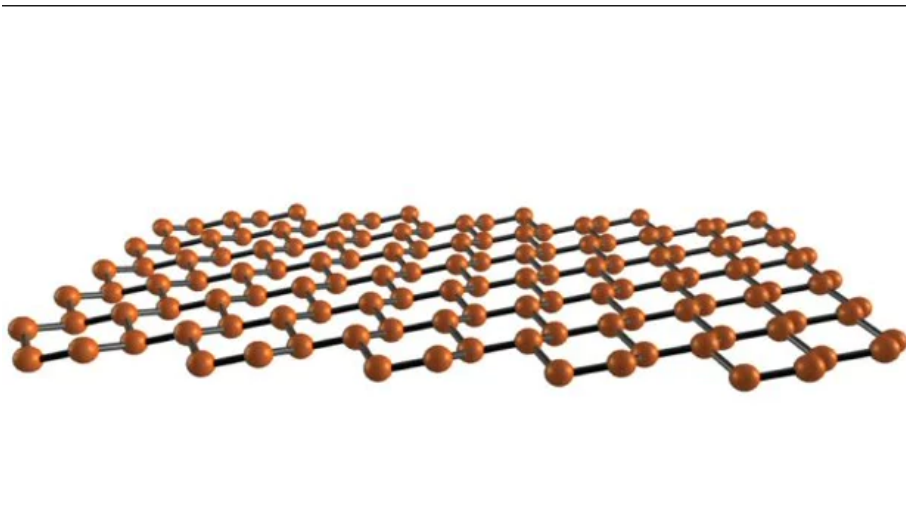
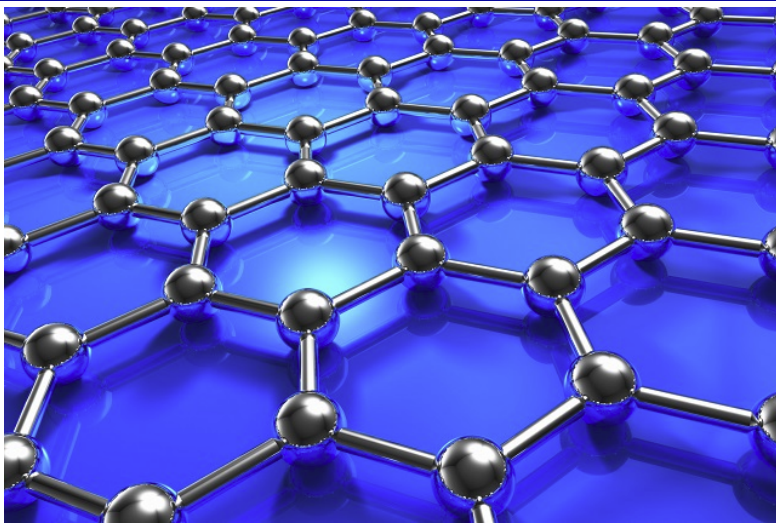


Αν θεωρήσουμε τα a_2 , b_2 ως διανύσματα αναφοράς τότε:

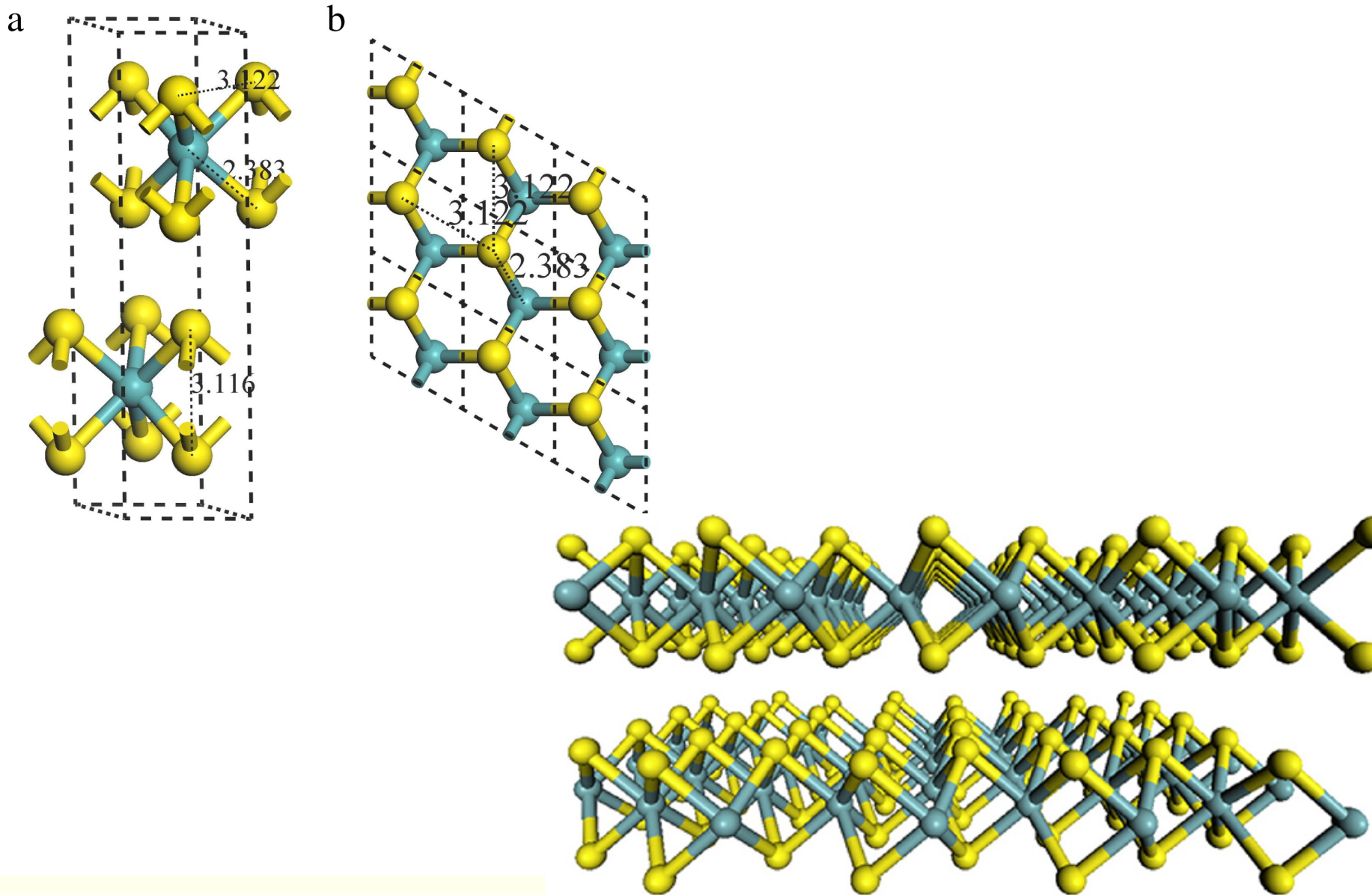
$$\vec{b}_3 = \vec{a}_2 + \vec{b}_2, \vec{a}_3 = \vec{a}_2$$

$$\vec{b}_4 = \vec{a}_2 - \vec{b}_2, \vec{a}_4 = \vec{a}_2$$

$$\vec{b}_1 = \vec{b}_2, \vec{a}_1 = 2 \times \vec{a}_2$$

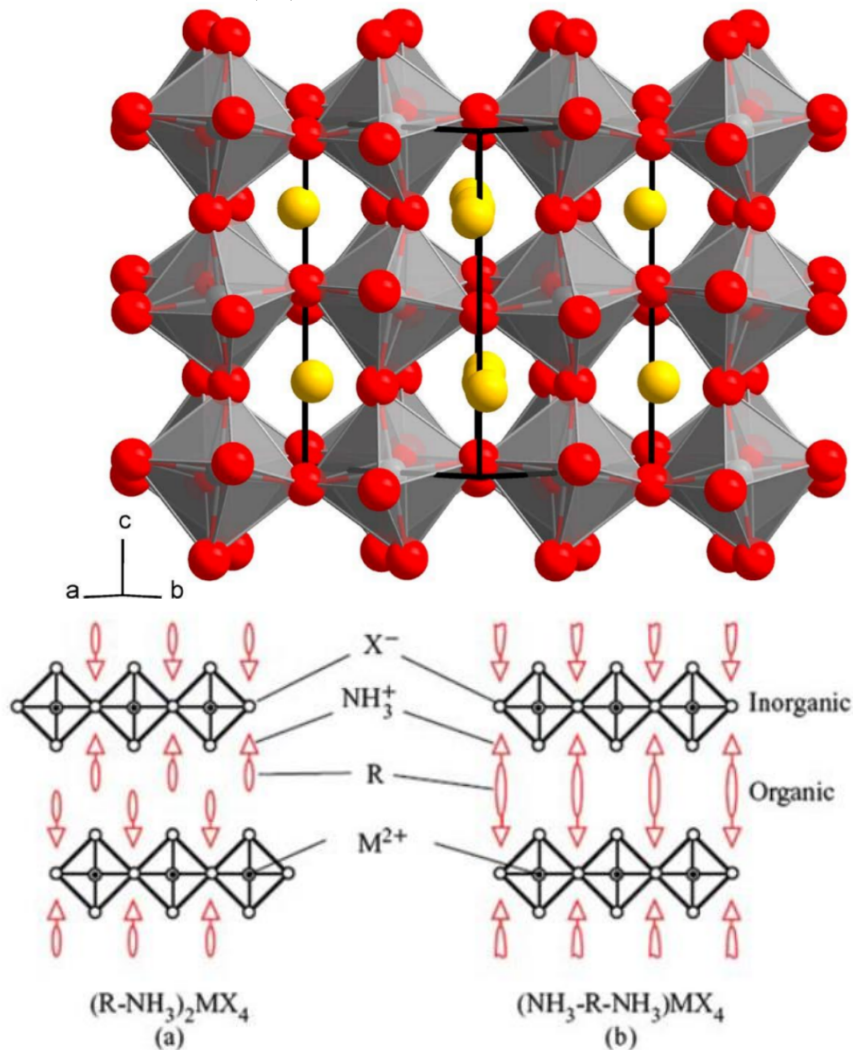
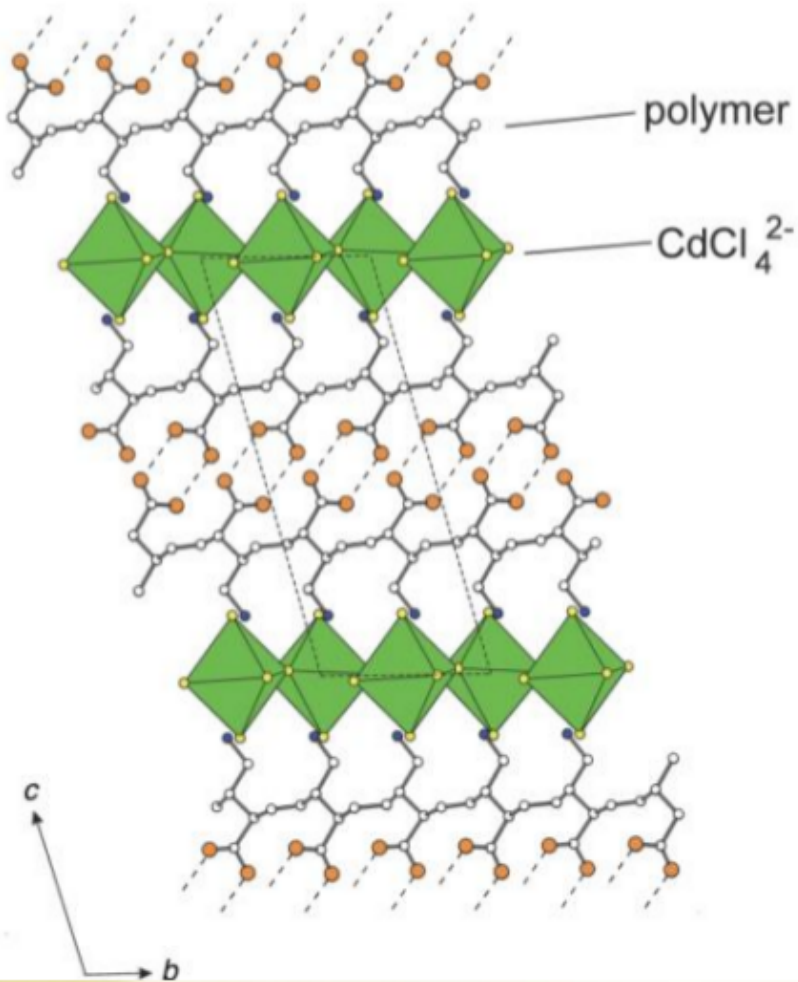


Group theory for structural analysis and lattice vibrations in phosphorene systems May 2015 Physical Review B 91(20)
DOI: 10.1103/PhysRevB.91.205421



Pseudo 2D Perovskites

6-amino-2,4-trans,trans-hexadienoic acid, within a cadmium (II) chloride perovskite framework





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- X. Li and H. Zhu, “Two-dimensional MoS₂: Properties, preparation, and applications,” *Journal of Materiomics*, vol. 1, no. 1, pp. 33–44, Mar. 2015. [4] I. Song, C. Park, and H. C. Choi, “Synthesis and properties of molybdenum disulphide: from bulk to atomic layers,” *RSC Adv.*, vol. 5, no. 10, pp. 7495–7514, Dec. 2014.
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