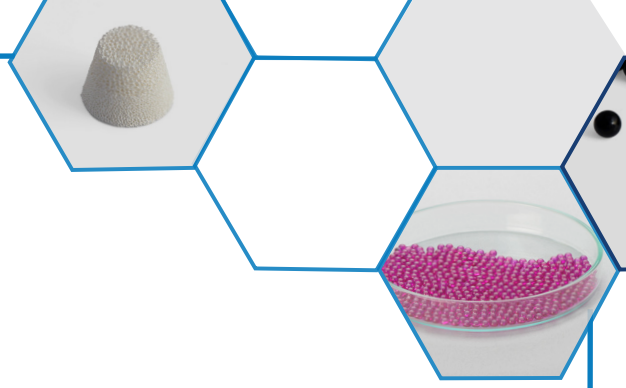

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PEROVSKITES

Perovskite materials have attracted significant attention as the most promising and efficient energy product for optoelectronics and photonics devices.

A Perovskite is a material that has the same crystal structure as the mineral Calcium Titanium Oxide or Calcium Titanate ($CaTiO_3$, also known as Perovskite). Calcium Titanate was discovered in 1983 by a Russian mineralogist called Perovski, from whom the material and its structure took their name.

As a group of materials, Perovskites have a unique and versatile crystal structure. This structure consists of a variation in the chemical formula ABX_3, where A and B are typically metal cations and X is an anion that bonds to both. In Perovskites, the 'A' cation is much larger than the 'B' cation.

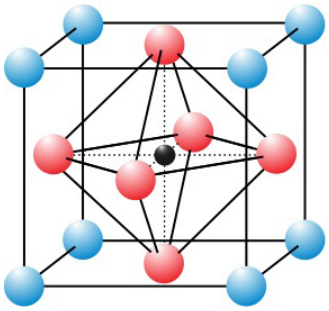
Perovskites have a cubic crystal structure, as represented in the adjacent diagram (blue spheres represent the 'A' cations, black spheres represent the 'B' cations and red spheres represent the 'X' anions), with many Perovskites occurring as oxides (ABO_3) or halides[1]. More complex structures can be produced by combining two different B-site cations. Perovskites are usually deposited as epitaxial thin films on top of other Perovskites by pulsed laser deposition or molecular-beam epitaxy.

Due to their lattice, Perovskites are characterised by special properties like superconductivity, magnetoresistance, piezoelectricity, ferroelectricity, dielectric and pyroelectric behaviour. In addition, a wide range of elements can be combined to form Perovskite structures, providing the possibility for selective design and for optimizing the structure's physical, optical and electrical characteristics[2].

Recently there has been increased interest in the development of low-dimensional (LD) Perovskite materials and in exploring their properties for photonic and optoelectronic device applications. In fact, reducing the dimensionality of three-dimensional bulk Perovskites has led to the formation of another class of Perovskite material known as layered Perovskites, with the ABO_3 structure separated by thin sheets of intrusive material such as an alkali metal[3].

Layered Perovskites can be considered a new class of materials with confined quantum structure and with huge potential for optoelectronic and electrical applications, such as in LED[4][5] devices. Moreover, these materials may well become the solution for a broad range of revolutionary applications, such as multilayer capacitors like fuel cells[6] , solar cells[7] , sensors and electrical batteries, or even next-generation display screens, memory devices (RAM)[8] and high-temperature superconductors. For example, Tin and Lead-based halide Perovskite solar cells are efficient due to their strong absorption in the visible spectrum, long charge-carrier diffusion lengths, tuneable band gap and easy manufacturing process[9].

[1] - https://commons.wikimedia.org/wiki/File:Perovskite_ABO3.jpg
[2] - https://www.cei.washington.edu/education/science-of-solar/perovskite-solar-cell/
[3] - https://doi.org/10.1016/B978-0-12-812915-9.00007-1
[4] - https://doi.org/10.1038/nnano.2015.90
[5] - https://doi.org/10.1038/s41566-019-0546-8
[6] - https://doi.org/10.1016/j.ijhydene.2012.09.141
[7] - https://doi.org/10.1016/j.solener.2015.12.045
[8] - https://doi.org/10.1080/000187399243455
[9] - https://doi.org/10.1038/s41467-019-10468-7



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