[1] A.K. Geim, **2009**. *Science 324(5934)*, 1530-1534. [2] H.L. Lee, *et al.* **2011**. *J. Am. Chem. Soc. 133,* 4447–4454.

**Keywords: graphite, grganometallic**

## MS52.P03

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**XRD characterization of bulk graphene-based material**

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Graphene is a nanostructure with unique physical properties that can be used to prepare a number of novel functional materials [1]. Bulk-quantities of graphene can be produced by exfoliation of expanded graphite with ultrasounds [2]. The expanded graphite is a commercial material which is obtained by thermal reduction of graphite oxide at temperatures close to 1000°C (graphite oxide is usually prepared by chemical oxidation of natural graphite using a mixture of strong chemical oxidants like: nitric acid, sulfuric acid and potassium permanganate). The degree of exfoliation strictly depends on the graphite oxidation level and the thermal shock treatment undergone by the graphite oxide; such a parameter is of a fundamental importance for the resulting physical properties of the nanostructured material that are prepared by intercalation of graphene with polymers and/or other types of nanostructures (e.g., CNTs, fullerenes, ceramic or metal nanoparticles, etc.).

The graphite oxidation/reduction process can be accurately investigated by wide-angle X-ray powder diffraction (XRD) [3] looking at the shift of the (002) peak in the diffraction pattern [4]. The presence of defects in the graphite structure like oxygen-groups (-OH, -COOH, etc.) and/or intercalated molecules (e.g., $H_2SO_4$) has the effect to modify the interlayer spacing, thus shifting the position of the peaks.

[1] A.K. Geim, K.S. Novoselov, *Nature Materials* **2007**, *6*, 183-191. [2] A.P. Yaroshenko, M.V. Savos'kin, A.N. Magazinskii, V.I. Shologon, R.D. Mysyk, *Russ. J. Appl. Chem.* **2002,** *75(6)*, 861-865. [3] *Quantum Dots: Synthesis and Characterization*, D. Dorfs , R. Krahne, C. Giannini, A. Falqui, D. Zanchet & L. Manna, *Book Title: Comprehensive Nanoscience and Technology (vol. 2),* Editors: Guozhong Cao, Duncan Gregory, Thomas Nann, Edited by: Elsevier, **2011**, 219-260. [4] Y. Wu, B. Wang, Y. Ma, Y. Huang, N. Li, F. Zhang, Y. Chen, Nano Res. **2010**, *3(9)*, 661-669.

**Keywords: graphene, graphite oxide, XRD**

## MS53.P01

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**Polymorphs of some common drugs and bioactive agents**

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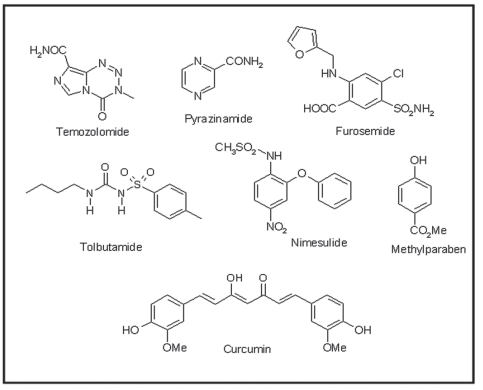
Novel polymorphs of important drugs such as Temozolomide, Pyrazinamide, Furosemide, Tolbutamide and Nimesulide, bioactive agents Methylparaben and Curcumin, and some model sulfonamides and hydroxybenzoic acids will be presented. We have found that screening against a large number of crystallization methods such as solvent-antisolvent, temperature variation and ramping, coformers and additives, solventless melt and sublimation techniques, and ionic liquids afforded novel crystalline forms of materials. Success seems to be more a factor of McCrone's famous dictum and the approach is still quite heuristic in terms of which methods work best for what kind of molecule. The success of our methodology will be presented through case studies involving different types of molecules taken up for polymorph search in our group.




[1] N. J. Babu, S. Cherukuvada, R. Thakuria, A. Nangia, *Cryst. Growth Des.* **2010**, *10* 1979-1989. [2] N.K. Nath, A. Nangia, *CrystEngComm*, *CrystEngComm*, **2011**, *13*, 47-51. [3] P. Sanphui, B. Sarma, A. Nangia, *J. Pharm. Sci.*, **2011**, DOI: 10.1002/jps.22464. [4] P. Sanphui, N.R. Goud, U.B.R. Khandavilli, S. Bhanoth, A. Nangia, *Chem. Commun.*, **2011**, DOI:10.1039/C1CC10204D.

**Keywords: crystallization, pharmaceutical, polymorphism**

## MS53.P02

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**High throughput crystallization of orcinol with various N-acceptor coformers: An alternative approach for exploring the structural landscape**

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An exhaustive search of the structural landscape of orcinol, 5-methyl-1,3-dihydroxybenzene, was carried out with high throughput crystallography. Polymorphs, pseudopolymorphs (solvates) and co-crystals are described. Several packing modes were identified for the orcinol co-crystals with various N-bases. In these several structural variations, the OH group conformations in the orcinol molecule (Figure 1) were found to depend on the choice of co-formers and the crystallization conditions employed. The study provides an alternative and more efficient approach to look into the various possibilities available for co-crystal formation.

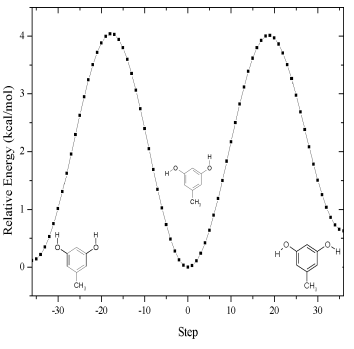


**Figure 1** Relaxed potential energy surface scan performed for the OH group rotations in the orcinol molecule.

**Keywords: hydrogen bonding, conformation, crystal engineering**

## MS53.P03

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**Polymorphism of a model arylboronic azaester – combined experimental and computational studies**

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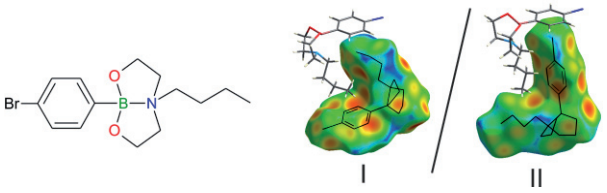
Arylboronic acids and their esters are very important reagents in synthetic chemistry and in medicine. Protection of boronic acids with appropriate diethanolamines leads to so-called azaesters, and enables their further functionalization. Azaesters of arylboronic acids exibit anti-cance, anti-hyperlidemic, anti-inflammatory and anti-neoplastic activities. Recently azaesters of arylboronic acids were found to show anti-microbial activity against *Streptococcus mutants* mainly responsible for tooth decay.




We have performed combined $^{13}C$ CP/MAS solid-state NMR, single-crystal X-ray diffraction and theoretical studies of two polymorphic structures of model arylboronic azaester (form **I** and **II**). It has been shown that the crystallization conditions determine the phase which is formed. Clear differences are visible in the solid-state NMR spectra, where the chemical shifts for the carbon atoms of form **I** are systematically shifted to higher frequency values, in comparison to form **II**. This can be correlated with the overall crystal field strength suggesting that structure **I** is more compact. This is confirmed by the X-ray diffraction results including crystal structure analysis (packing and Hirshfeld surfaces). Molecular geometries of both forms are fairly similar. Some discrepancies have been found in the conformations of the bicyclic moieties, especially for the lengths of the B–N bonds. The most striking differences between the molecules of different polymorphic forms are observed in Hirshfeld surfaces and fingerprint plots. Thermal-expansion tensor and multi-temperature unit-cell X-ray analysis show significant differences between the forms **I** and **II**. This is especially clear when comparing the thermal expansion of crystals in different crystal directions. Our analysis of molecular dipole moments in crystals provides a clear picture of differences for both polymorphs, however, according to computations the dispersion contributions plays a very important role. Theoretical calculations, using *PIXEL* and *CRYSTAL09* programs, are in perfect agreement. They show that the proper handling of the dispersion correction is extremely important for molecular crystals. Calculated lattice energies suggest that the form **I** is slightly more stable than the form **II**. This is also reflected in the crystallization kinetics and melting point temperatures. The higher lattice energy in form **II** seems to be partially compensated by the lower conformational energy of the independent molecules in this form.

[1] K. Durka, A.A. Hoser, R. Kamiński, S. Luliński, J. Serwatowski, W. Koźmiński, K. Woźniak, *Cryst. Growth&Design*, **2011**, accepted.

**Keywords: polymorphism, boron, theoretical**

## MS53.P04

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**Crystal structure of the drug diethylcarbamazine and a new maleate salt**

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The Drugs for Neglected Diseases Initiative (DNDi) was created to improve the quality of life for people affected by disease such as lymphatic filariasis (LF). Although the drugs used to treat this disease were developed long ago, little is known about their mechanisms of action. Diethylcarbamazine (DEC-CIT) citrate is one of the most widely used drugs in the treatment of FL. However, very little information about its solid-state characteristics can be found in the literature[1-3]. In a previous study we crystallized and analyzed DEC-CIT by thermal methods, vibrational and X-ray diffraction, revealing three phase transitions at low temperatures, resulting in changes in its molecular structure[4]. In the current study, we crystallized and analyzed the solid state properties of DEC in its pure form and in a new salt form with maleic acid, in order to establish relationships concerning their behavior under different molecular crystals arrangements.

DEC crystallizes in the monoclinic space group $P2_1/n$ with four molecules per unit cell. The pattern of molecular interactions is composed only of weak interactions of types C-H•••O and C-H•••N, forming trimers, unlike what occurs for the citrate salt (DEC-CIT), where citrate molecules form strong bonds with the drug molecules and each other. These weak interactions result in a low density arrangement, which dissolves as the temperature increases. Studies of single crystal X-ray diffraction at different temperatures showed the absence of phase transitions. Above 250K the crystal diffraction stops due to a slow amorphyzation process that leads to a loss of crystallinity, and evolves into a completely amorphous state at room temperature. DSC experiments confirmed the fusion of DEC around 320K, while the one for DEC-CIT was around 410K. IR and Raman spectra were recorded and were consistent with the structural features shown by DSC.

Diethylcarbamazine maleate (DEC-M) crystallizes in the triclinic space group P-1 with two very similar conformations of DEC molecule and two molecules of maleic acid per asymmetric unit. In this new salt, we observed a *cis* conformation for both ethyl chains of the DEC molecules at room temperature. This conformation was only observed in DEC-CIT under 100K, and are *anti* related in the other structures. The crystal structure is stabilized by N-H•••O interactions between the DEC and maleic acid molecules. Besides these interactions, there is a complex network of C-H•••O interactions, which stabilize the compound in a sandwich-like arrangement, interspersed with layers of DEC over bilayers of maleic acid. This new arrangement keeps the compound stable at room temperature. Studies as function of temperature by DSC, IR and Raman spectroscopy confirmed the absence of phase transitions as observed for DEC-CIT. Although solubility tests are still necessary, it is believed that the new crystal packing releases DEC molecules more quickly in solution, making this new compound a strong candidate for active pharmaceutical ingredient (API), while the weak interactions and low melting point disqualify the DEC in its pure form as an API.

[1] R.E. Don, Chatelain, *Drug Discovery for Neglected Diseases: View of A Public–Private Partnership*. ed.; Wiley-VCH Verlag GmbH & Co. KGaA: **2009**, 33-43. [2] P.J. Hotez, D.H. Molyneux, A. Fenwick, J. Kumaresan, S.E. Sachs, J.D. Sachs, L. Savioli, *Control of Neglected Tropical Diseases. In ed.* **2007**, *357*,1018-1027. [3] R.P. Tripathi, D. Katiyar, N. Dwivedi, B.K. Singh, J. Pandey, *Current Medicinal Chemistry* **2006**, *13*, 3319-3334. [4] C.C.P. da