# SPECIFIC HEAT, MEAN ATOMIC WEIGHT AND RELICT TEMPERAURES OF BURSA L6 CHONDRITE.

R. A. Wach[1], M. Szurgot[2], O. Unsalan[3] and C. Altunayar-Unsalan[4], [1]Lodz University of Technology, Institute of Applied Radiation Chemistry, Wróblewskiego 15, 93 590 Lodz, Poland (wach@mitr.p.lodz.pl), [2]Lodz University of Technology, Center of Mathematics and Physics, Al. Politechniki 11, 90 924 Lodz, Poland (mszurgot@p.lodz.pl), [3]Ege University, Faculty of Science, Department of Physics, 35100, Bornova, Izmir, Turkey (physicistozan@gmail.com), [4]Ege University, Central Research Testing and Analysis Laboratory Research and Application Center, 35100, Bornova, Izmir, Turkey (cisemaltunayar@gmail.com).

**Introduction:** Thermophysical properties and mean atomic weight are important for characterization of extraterrestrial rocks and their parent bodies: asteroids and planets. Differential scanning calorimetry (DSC) is widely used for measuring specific heat capacity of extraterrestrial matter, temperature of phase transformations, and enthalpy changes in terrestrial and meteoritic minerals. The aim of the paper was to measure specific heat capacity of Bursa meteorite at various temperatures, to measure grain density, determine relict temperatures, troilite content, mean atomic weight, and mean atomic heat of this chondrite. Bursa meteorite fell in 1946, in Turkey, and have been classified as a L6 chondrite.

**Methods:** Specific heat capacity *Cp* of crushed samples (c.a. 20 mg) were determined by a DSC Q200 (TA Instruments, USA) in the temperature range between 223 and 623 K. Literature data on chemical composition of Bursa chondrite [1] were used to calculate *Amean* and *Fe/Si* values. Apart from the bulk composition, also *Fe/Si* ratio and measured grain density *dgrain* were used to predict *Amean* values using *Amean(Fe/S*i), and *Amean(dgrain),* relationships, established by Szurgot (e.g. [2-4]). Relict temperatures and troilite content were determined using DSC technique and troilite thermometry (e.g. [5,6]).

**Results and discussion:** It was established that the mean specific heat of four Bursa interior samples in temperature range between 223 and 623 K increases from 603 to 971 J/(kg·K). *Cp* values of individual samples exhibit significant differences. Specific heat capacity of sample 1, for example, is between 571 and 1038 J/(kg·K), and of sample 2 is between 630 and 978 J/(kg·K), at temperatures 223 K and 623 K, respectively. The mean values of *Cp* vary with the temperature and are equal to: 603±33 J/(kg·K) at 223 K, 772±32 J/(kg·K) at 323 K, 837±36 J/(kg·K) at 373 K, 896±48 J/(kg·K) at 473 K, and 934±35 J/(kg·K) at 573 K.

Measurements of specific heats of individual Bursa interior samples at room temperature (300 K) exhibited the following values: 686, 711, 737, 747, 748, 760, and 788 J/(kg·K) (mean:740±33 J/(kg·K), range: 686-788 J/(kg·K)). Mean atomic heat (*Amean·Cp*) of Bursa chondrite: 17.5±0.9 kJ/(mol·K) at room temperature.

Room temperature values of specific heat of Bursa meteorite are close to *Cp* of other ordinary chondrites: L chondrites: 742 J/(kg·K) [7], H chondrites: 714 [7], Braunschweig L6 chondrite: 727±32 J/(kg·K) [6], Soltmany L6 chondrite: 728±35 J/(kg·K) [5], Jilin H5: 726±13 J/(kg·K) [8], and Gao-Guenie H5: 732±7, 740 ±27 J/(kg·K) [8].

Bursa *Fe/Si* atomic ratio (0.563) is close to the average for L6 falls: 0.60 ± 0.04, and is within the L6 range: 0.53-0.65 [3]. Mean atomic weight of Bursa: *Amean* = 23.61±0.17 (average of *Amean(Bulk composition)* = 23.41, *Amean(Fe/Si))* = 23.71, and *Amean(dgrain)* = 23.70) is close to the mean atomic weight of L6 chondrite falls (average: 24.06 ± 0.16, range: 23.6-24.4, [3]). Average values of *Amean's* and *Fe/Si* for OC's follow the inequalities [4]:
*AmeanLL*(22.90)<*AmeanL/LL*(23.34)<*AmeanBursa*(23.61)≈*AmeanL*(23.67)<*AmeanH/L*(24.32)<*AmeanH*(24.63),
*Fe/SiLL*(0.52) < *Fe/SiL/LL*(0.54) < *Fe/SiBursa*(0.56) < *Fe/SiL*(0.59) < *Fe/SiH/L*(0.73) < *Fe/SiH*(0.81).

Measured grain density of Bursa meteorite *dgrain* = 3.52±0.02 g/cm$^3$, and predicted by *dgrain(Amean)* relationship [2,3,9,10] *dgrain(Amean)* = 3.51±0.02 g/cm$^3$, and *dgrain(Fe/Si)* relationship [10] reveals grain densities: 3.54±0.02 g/cm$^3$ for the Bursa whole rock.

Relict temperature of interior Bursa samples measured by troilite thermometry reveal range: 55-77 $^o$C, and crust sample reveals relict temperature: 222±30 $^o$C. Troilite content in Bursa meteorite determined by DSC measurements of troilite α/β solid transition is: 5.6±0.2 wt.%., and resulting from ICP-MS data on sulfur content is: 5.5±0.2 wt%.

**Conclusions:** Mean atomic weight, and *Fe/Si* ratio indicate that Bursa belongs to L6 chondrites, as previously established. *Amean* and *Fe/Si* ratio satisfactorily predict grain density of Bursa meteorite. Specific heat capacity of Bursa meteorite is comparable with measured *Cp* values of various ordinary chondrites.

**References:** [1] Kaygisiz E. et al. (2019) *72nd Geological Congress of Turkey*, Abstracts:399-400. [2] Szurgot M. (2015) *LPSC 46*, Abstract #1536. [3] Szurgot M. (2015) *Acta Societatis Metheoriticae Polonorum* 6:107-128. [4] Szurgot M. (2016) *LPSC 47*, Abstract #2180. [5] Szurgot M. et al. 2012. *Meteorites* 2:53-65. [6] Bartoschewitz R. et al. 2017. *Chemie der Erde* 77:207-224. [7] Yomogida K. and Matsui T. 1983. *Journal of Geophysical Research* 88:9513-9533. [8] Beech M. et al. 2009. *Planetary and Space Science* 57:764–770. [9] Szurgot M. (2018) *LPSC 49*, Abstract #1039. [10] Szurgot M. (2018) *LPI Contribution No.2067*, Abstract #6001.