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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A chemical model of meteoric ablation" *by* T. Vondrak et al.

Anonymous Referee #1

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This is a very good paper and goes a long way towards addressing the development of comprehensive model for meteoroid-atmosphere interactions. It should definitely be published, although, perhaps, after some revision. I recommend that the authors re-examine the role of sputtering in this interactions, and, perhaps, qualify the conclusions.

In the preliminary comments, I mentioned problems in the work by Hawkes and his students (Hill, Rogers et al. 2004; Rogers, Hill et al. 2005). These problems are several:

(1) The term “sputtering” generally refers to ejection of neutrals or ions by ion impact on surfaces. The work by Tielens et al. (Tielens, McKee et al. 1994) specifically applies to ion impact on surfaces. The ions they consider and which they study experimentally, and for which they develop the theory are interstellar ions, such H+, He+, D+, and others. The yields they calculate and the theory they develop apply to

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these projectiles. Their targets are similar to meteoroids. The authors might also wish to examine the recent reviews provided by (Behrisch and Eckstein 2007) who discuss the latest approaches to experiment and theory in obtaining the sputtering yields. Thos for neutral atom impact on surfaces are quite low. In using the theoretical framework developed by Tielens et al, the authors should keep this framework in mind and might wish to leave a little bit of wiggle room in their conclusions.

(2) When molecular gases collide with surfaces at hyperthermal energies, other physical-chemical processes can become important, such as reflection, decomposition, as well as negative ion formation The authors may wish to examine a review by (Kleyn 1992) who shows data for O2+ impact on surfaces at ˜ 300 eV. In that case neutralization followed by reflection seems to be the dominant process. For the cases of neutral and ionized rare gases impacting silica surfaces, the former leads to sputtering, while the latter leads to compaction of the silica surfaces, as shown by the study of (Mizutani 1995). There is also a review by (Greber 1997) which includes the study of O2 impact on surfaces of Na and Cs at low energies. In this case negative ions are formed abundantly.

(3) Hill et al. (2004) are not clear about the atmospheric densities they use. It is not clear how the mass density profile given in their Figure 2 and the number densities given in their Figure 3 are related and what the average conditions are.

(4) Other papers have appeared which invoke sputtering as a mechanism for the evaporation of meteoroids (Popova, Strelkov et al. 2007; Vinkovic 2007). They have the same failings, but the authors may wish to refer to them.

(5) Finally, with regards to sputtering, the authors may wish to use the term etching instead, which is supported by the laboratory studies mentioned here.

(6) I have no comments about the rest of the paper, as Professor Plane and his students have perfected a good model that seems to work reasonably well when considering the thermal evaporation of meteors. The only suggestion I have is that they add a reference

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to the work of Alexander (Alexander 2001) which is in substantial agreement with their work.

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Kleyn, A. W. (1992). "Dissociation in molecule-surface collisions." J. Phys. Cond Matter 4: 8375-8394.

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Popova, O. P., A. S. Strelkov, et al. (2007). "Sputtering of fast meteoroids' surfaces." Adv. Space. Res. 30: 567-573.

Rogers, L. A., K. A. Hill, et al. (2005). "Mass loss due to sputtering and thermal processes in meteoroid ablation." Planet. Space Sci. 53: 1341-1354.

Tielens, A. G. G. M., C. F. McKee, et al. (1994). "The physics of grain-grain collisions and gas-grain sputtering in interstellar shocks." Ap. J 431: 321-340.

Vinkovic, D. (2007). "Thermalization of sputtered particles as the source of diffuse radiation from high altitude meteors." Adv. Space Res. 39: 574-582.

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