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Reply to comment by M. Bodeau on "Charging of mirror surfaces in space"

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[1] The first comment of *Bodeau* [2006] is about the Boeing ownership or acquisitions of companies and satellites. Since I had no knowledge of the companies or the details of acquisitions, and because this is not a scientific question, I will offer no further comment on this point. I thank M. Bodeau for this information.

[2] *Bodeau* [2006] comments at length, presenting supporting laboratory measurements, that sputtering rates are small and concludes that sputtering can not cause a sudden stepwise loss of power on Satellite PAS-7. Indeed, *Lai* [2005] has explored sputtering as a plausible mechanism and obtained a numerical estimate of the surface removal rate by sputtering. The rate obtained by *Lai* [2005] is of the order of 10^{-11} cm per month. The conclusion section in the work of *Lai* [2005] states: "Although the sputtering rate is small, prolonged sputtering would shorten the useful life of the mirrors. Unlike sudden discharges, which may cause damage or stepwise degradation to the solar cells, sputtering causes gradual degradation only to the solar cells." This conclusion of *Lai* [2005] is not in disagreement with that of *Bodeau* [2006].

[3] *Bodeau* [2006] comments that PAS-7 has no mirror. I thank M. Bodeau for this information. However, the PAS-7 articles posted on 27 and 28 September 2001 on SpaceToday.net (<http://www.spacetoday.net/Summary/408>) and SpaceDaily (<http://www.spacedaily.com/news/panamsat-01b.html>), respectively, show a satellite picture with mirrors flanking the solar panels. If PAS-7 does not feature mirrors, I agree that the proposed differential charging mechanism would not apply. For Boeing 702 satellites, see http://www.boeing.com/defense-space/space/bss/factsheets/702/galaxy_xi/galaxy_xi.html. As a

consequence of degradation, future 702 satellites will be equipped with conventional solar arrays (see the Sat-Index Web site, available at <http://www.sat-index.com/failures/702arrays.html>).

[4] The main point in the work of *Lai* [2005] is a novel postulate that mirrors of high reflectance emit little or no photoemission. With low photoemission, the mirrors may charge to high negative voltages even in sunlight, when the ambient space plasma is hot enough. Charging of mirrors has never been studied in the laboratory. If the satellite surfaces, including parts of the solar panels, emit abundant photoelectrons in sunlight, they would not charge, or charge to low positive potentials only. If so, differential charging may occur on the satellite more often than previously thought. It may occur not only during eclipse periods, which are indeed short, but also sometimes in sunlight when a critical temperature is exceeded. If PAS-7, or any satellite, does not feature reflectors, the proposed differential charging mechanism would not apply.

[5] **Acknowledgment.** Amitava Bhattacharjee thanks Henry Garrett for the assistance in evaluating this paper.

References

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