iSolate™ nanotech protects hearing instruments even better than before

Rena Appleby, AuD.

Extreme temperatures and humidity levels can cause havoc in all parts of our lives if not controlled. We, as human beings, are able to endure the extreme outdoor changes in climate by layering our clothing when it is cold outside and decreasing the number of layers when it is warm and humid outside. In addition, we can go indoors where we can more easily manipulate the temperature and humidity levels. We use the same logic when "weatherizing" our property. Outdoors, we seal our roofs and driveways to protect them from the elements and indoors we control the temperature and humidity in libraries and art museums to preserve books and artwork.

The temperature and humidity levels within our own ear canals can also be problematic, often creating a desirable environment for bad bacteria and an undesirable environment for hearing instruments. Individuals with middle ear pathology or those who wear hearing aids were found to have higher rates of relative humidity in their ear canals than a "normal" ear group (Gray et al, 2005). According to Hall and Croutch[1], ambient relative humidity levels (humidity in the environment) might contribute to higher ear humidity readings within the ear canal as well. Since we have minimal ability to control these levels, anything placed into this environment must be able to withstand these conditions. Every time a hearing instrument is placed in the ear, it is subjected to these extreme conditions as well as other debris found naturally within the ear, such as cerumen. In addition, certain sprays and gels used outside the ear canal may also inadvertently come into contact with the hearing instrument. How many small electronic devices could operate at an optimal level for any period of time under these harsh conditions?

Not surprisingly, the study conducted by Hall and Croutch[1], showed a strong correlation between relative ear canal humidity ratings and the rate of hearing instrument receiver repairs. The study showed that seventy eight percent of subjects who had a high rate of hearing instrument receiver repairs had relative ear canal humidity ratings greater than 60 % compared with the non-receiver repair group who had relative humidity ratings that were all below 60 %. In addition, Bailey and Valente[2] measured the temperatures in ITC and ITE devices worn by subjects and found most of the readings to be between 80-99 degrees Fahrenheit.

No matter what the cause of these hearing instrument breakdowns, the overall consumer perception is that hearing instruments are not reliable. According to Kochkin[3], 20 % of hearing aids users were not satisfied with the reliability of their hearing instruments and 16 % returned their devices due to reliability issues[4]. In addition, 30 % of non-hearing aid users reported that hearing aids do not work in humid climates[4]. It is understandable that unreliability would be a major issue for users. A repair that cannot be done by the clinician in the office might mean that the user must do without the hearing instrument for several days to a week. If out of warrantee, the cost of a typical repair may be $100 or more depending on the severity of the issue.

What can happen to hearing instruments?

- Moisture and condensation on conductive surfaces such as battery springs can lead to issues including short circuiting, leakage currents, formation of corrosion, and migration of conductive material.
- Perspiration contains salts, and worsens the issues caused by moisture.
- Leakage of the alkaline electrolyte from the battery can cause short circuiting.
- Cerumen blocks openings in the device and adheres to surfaces, which can lead to discoloration over time.
- Deposits of oil and debris from handling the hearing instruments can clog openings as well. In addition, perfumes and hair products can cause blockages or breakdown of components.

iSolate™ technology addresses some of these issues through sealing and coating of individual components. Silicone sealants applied to transducers, user controls and the integrated circuit minimize the damaging effects of moisture while metal coating of conductive surfaces like battery springs helps retard corrosion. However, such targeted protection inevitably leaves some areas of the hearing instrument vulnerable. As an extension to iSolate™ technology, iSolate™ nanotech completely engulfs every inner and outer surface of the hearing

instrument with a polymer protective coating 1,000 times thinner than a human hair.

iSolate™ nanotech is applied to multiple completed hearing instruments at a time in a vacuum chamber using a special ionized gas. This process changes the surface properties of all parts of the hearing instruments to be extremely liquid repellent. As a result, any liquid that comes into contact with a surface that has been treated with iSolate™ nanotech will form a bead and roll off. ReSound qualifies hearing instruments with an intensive 5-week Accelerated Screen Test (AST) that among other forms of distress for the devices includes tests for salt mist and humidity, temperature cycling and cyclic damp heat. Figure 1 shows two BTE devices that were subjected to AST testing. The device at the top of the picture did not have iSolate Nanotech coating, while the device below did. The non-coated device shows clear signs of corrosion in several locations. Figures 2 and 3 summarize AST results for 30 hearing instruments, half of which had iSolate ™

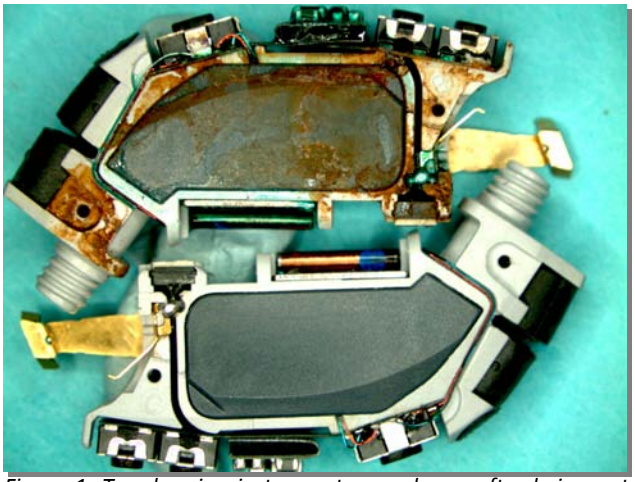

Figure 1. Two hearing instruments are shown after being put through environmental testing. The hearing instrument in the lower part of the photo is protected with iSolate™ Nanotech. The non-coated instrument is visibly corroded. No damage was observed on the instrument with iSolate™ nanotech.

nanotech protection and half of which did not. After just 2 weeks of testing, 4 devices without iSolate™ nanotech showed visible signs of corrosion while 3 devices failed standard quality testing. After 5 weeks of testing, 8 of the non-treated hearing instruments were visibly affected, while 9 of the 15 failed quality testing. None of the devices with iSolate™ nanotech failed or showed signs of corrosion at any point during the AST. These results are clear indicators that iSolate™ nanotech may nearly eliminate the classic type of failures related to the harsh operating environment of hearing instruments.

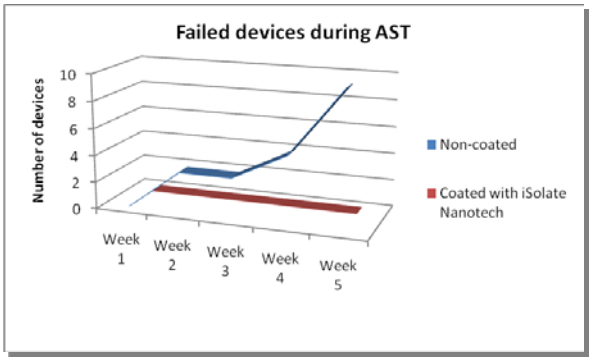

Figure 2. Hearing instruments with and without iSolate™ nanotech were subjected to AST. None of the protected devices failed subsequent quality testing.

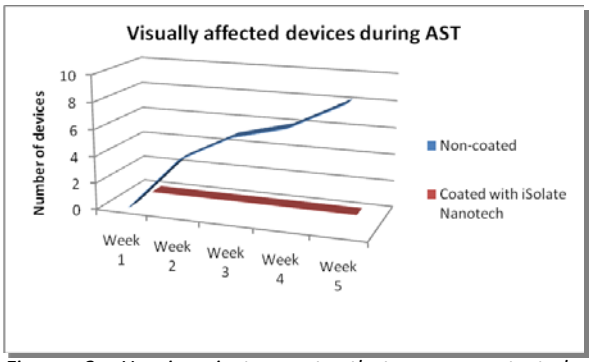

Figure 3. Hearing instruments that were protected with iSolate™ nanotech showed no visible signs of corrosion following AST.

Summary

Hearing instruments must function under tortuous conditions involving exposure to moisture and humidity, variations in temperature and exposure to damaging salts, debris, solvents and earwax. iSolate™ nanotech extends iSolate™ protective technology to wholly shield all hearing instrument surfaces. This nanoscopic treatment causes any moisture to bead up and roll off the devices, thereby preventing the conditions for associated damage to occur. iSolate™ nanotech represents a significant step in improving user satisfaction with hearing instruments.

References

1. Hall M, Crouch C. A field study on the effect of relative humidity on hearing aid receivers. *Hearing Review*. 2010; 17(1):32-25.
2. Bailey JW, Valente M. Measurements of relative humidity and temperatura in hearing aids. *Hearing Journal.* 1996; 49(10):59-63.
3. Kochkin S. MarkeTrak VIII: Customer satisfaction with hearing aids is slowly increasing. *Hearing Journal*. 2010; 63(1):11-19.
4. Kochkin S. Obstacles to adult non-user adoption of hearing aids. *Hearing Journal*. 2007; 60(4):27-43.