Impedans
PLASMA MEASUREMENT

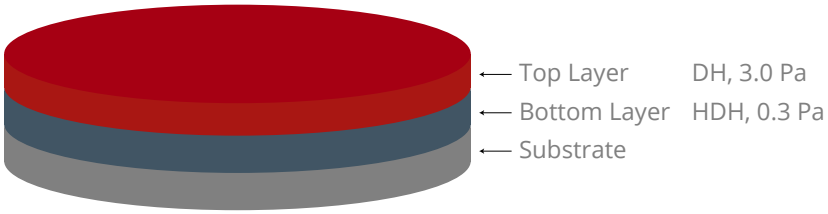
Semion Retarding Field Energy Analyser (RFEA) used in a study to form Ti–Cu thin films with regard to controlling the copper release*

STUDY

Serious complications in orthopaedic surgery include aseptic loosening and infection of artificial implants. A number of studies have looked at ways to reduce these complications, and copper has been found to be one of the most promising metal ions for deposition applications because of its lower toxicity and higher cytocompatibility. Various studies have shown that sufficient (about 5 mmol/l) copper release over at least several days is needed to inhibit and then kill all bacteria. This study aimed to prepare Ti–Cu film with strong initial antimicrobial and cytotoxic effect, followed by long-lasting but moderate copper release using HiPIMS-based systems.

METHOD

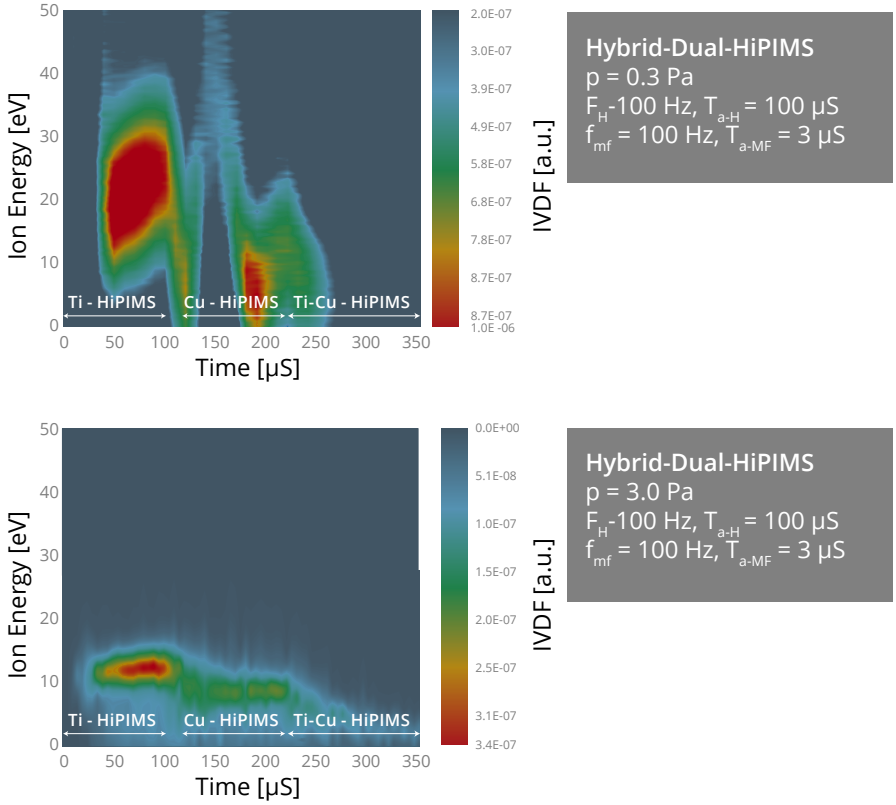
In the study, Ti–Cu films were prepared by ionized physical vapor deposition arranged in both dual-HiPIMS (DH) and hybrid-dual-HiPIMS (HDH) configurations – see below. Both configurations used two sputtering sources with Ti and Cu targets measuring 50 mm in diameter.



A grounded Semion Retarding Field Energy Analyzer (RFEA) was used at the substrate position to take time-resolved measurements of ion velocity distribution function (IVDF). The measurements were taken by “boxcar method” using 5 μs period for data averaging.

FINDINGS

The following graph shows the time-resolved measurement of the IVDF, performed at working pressures 0.3 Pa and 3.0 Pa using the Semion RFEA.



The study found that the energy of ions is strongly affected by the pressure, measuring several times higher at low pressure. The ion energy also influences crystallographic film formation. In addition, the study indicated that structural changes are caused by the energy of deposited species. At higher pressures, grain-like structure with large Cu crystals was formed, and this increased an effective film area that encouraged the copper release.

CONCLUSION

This study demonstrated that an appropriate combination of deposited sub-layers (double-layer film) manages to achieve controlled copper release.

REFERENCES

* Vitezslav Stranak, Harm Wulff, Petra Ksirova, Carmen Zietz, Steffen Drache, Martin Cada, Zdenek Hubicka, Rainer Bader, Milan Tichy, Christiane A. Helm, Rainer Hippler.
"Ionized vapor deposition of antimicrobial Ti–Cu films with controlled copper release".
Thin Solid Films Volume 550, 1 January 2014, Pages 389–394. doi:10.1016/j.tsf.2013.11.001.
Published 13 November 2013.

Impedans Ltd.
Chase House, City Junction Business Park, Northern Cross, Dublin 17, Ireland.
Ph: +353 1 842 8826 | Fax: +353 1 891 6519 | Web: www.impedans.com | Email: info@impedans.com
Follow IMPEDANS