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This Week's Citation Classic

Redhead P A. Thermal desorption of gases. *Vacuum* **12**:203-11, 1962. [Radio and Electrical Engineering Division, National Res. Council, Ottawa, Canada]

The heating in vacuum of a solid sample, on which gases have been previously adsorbed, results in a spectrum of pressure changes. This paper shows how to calculate various desorption parameters from the thermal desorption spectrum. [The *SCI*® indicates that this paper has been cited over 360 times since 1962.]

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"The development of ultra-high vacuum techniques in the 1950s led to a rapid increase in research devoted to the study *of* interactions at well-characterized metal surfaces. J.A. Becker[1] at Bell Labs and G. Ehrlich[2] at General Electric developed the flash-filament method, as it was then called, to study the adsorption of gases on clean metal surfaces. This method involved the cleaning of a refractory metal sample (usually a polycrystalline wire at that time) by heating in UHV, followed by adsorption of the sample gas on the clean surface. The sample was then heated in a suitably programmed way and the resulting pressure changes recorded, a process we would now call thermal desorption spectrometry (TDS).

"Reaction rate measurement at continuously varying temperatures was first proposed by Urbach in 1930[3] and had been used for many different studies of chemical kinetics. The flash-filament technique for the study of adsorption kinetics was first described by L. Apker in 1948[4] and further developed by J.A. Becker and H.D. Hagstrum[5] at Bell Labs in 1952-53 who introduced the use of a continuously varying temperature program. G. Ehrlich[6] demonstrated how the thermal desorption spectra could be analysed to yield data on the surface population in various adsorbed phases and the parameters of their desorption kinetics.

"My paper is a simple extension of Ehrlich's work which had thoroughly laid out the groundwork. All that I contributed was to show how easy it was to calculate the desorption parameters from a differentiated form of the spectrum. The differentiated form being obtained either by electronic differentiation of a fast spectrum or by using the pumping speed of a vacuum system to differentiate a slow spectrum. I submitted the paper to the *journal of Applied Physics,* which had published Ehrlich's paper, since it appeared to me that it should follow Ehrlich's paper. It was rejected on the grounds that it was too applied for that journal, and would be more suitable for a vacuum technology journal. The paper was then accepted by *Vacuum* whose editor was surprised to receive, a month later, a manuscript from George Carter[7] covering much the same ground. The following editor's note appeared beneath the abstract of Carter's paper — *By coincidence, shortly before VACUUM received this paper by Dr. Carter, a paper from Canada was received which Dr. Carter's paper partly duplicated. This was 'Thermal Desorption of Cases' by P.A. Redhead, Vacuum 12, 203 (1962). Dr. Carter's paper leads to identical conclusions. In order to indicate the nature of the work carried out in England, Dr. Carter has, at our request, abbreviated section (a) of his paper, which now consists of a short review of this part of his work.* I have long since apologized to George for the frustrations that my colonial intervention caused him and I trust I have been forgiven.

"The coincidence in the appearance of these two papers is one of the vagaries of the research process which I find just as surprising as my paper becoming a *'Citation Classic.'* Perhaps my paper attracted frequent citations because of its simplicity, certainly it was not because of its originality."

1. **Becker J A & Hartman D C.** Field emission microscope and flash-filament techniques for the study of structure and adsorption on metal surfaces. *J. Phys. Chem.* **57**:153-9, 1953.
2. **Ehrlich G.** The interaction of nitrogen with a tungsien surface. *J. Phys. Chem.* **60**:1388-400. 1956.
3. **Urbach F.** Zur lumineszenz der alkalihalogenide II. messungsmethoden; erste ergebnisse; zur theorie der thermolumineszenz. *Sitzber. Akad. Wiss. Wien. Math-nature. Abt 11a* **139**:363-72, 1930.
4. **Apker L.** Surface phenomena useful in vacuum technique. *Ind. Eng. Chem.* **40**:846-7, 1948.
5. **Hagstrum H D.** Instrumentation and experimental procedure for studies of electron ejection by ions and ionization by electron impact. *Rev. Sci. Inst.* **24**:1122-42, 1953.
6. **Ehrlich G**. Kinetic & experimental basis of flash desorption. *J. Appl. Phys.* **32**:4-15, 1961.
7. **Carter G**. Thermal resolution of desorption energy spectra. *Vacuum* **12**:245-54, l962.