Applied Physics Seminar

Lunch time, Every Wednesday

APPH E4901: Discussion of specific and self-contained problems in areas such as applied EM, physics of solids, and plasma physics.
Topics change yearly.

APPH E4903: Discussion of specific and self-contained problems in areas such as applied EM, physics of solids, and plasma physics.
Formal presentation of a term paper required.
Topics change yearly.

The Fusion Systems Corporation Story

L. S. Levine[1]

Fusion Systems Corporation is a successful $50 million per year high-tech manufacturing company based in Rockville, Maryland. It consists of two businesses, each of which develops, builds and sells capital equipment to a variety of end-users around the world. The first business makes equipment for UV-curing, which is an important niche technology for "drying" special inks, coating and adhesives for a multitude of applications in many industries. The second business makes front-end processing equipment for integrated circuit fabrication. In addition, we have spawned a new company, Fusion Lighting, Inc., which is pursuing some novel concepts aimed at niches in the visible lighting industry.

Each of these businesses had its origin in a core technology which the five founders of Fusion Systems Corporation—all trained in fusion-related science and technology—developed in the early 1970s. The technology uses commercial microwave power to excite a low-temperature, partially-ionized sealed discharge which is a highly efficient emitter of ultraviolet and/or visible radiation. In other words, we developed a high power microwave driven electrodeless lamp.

This technology derived, in a rather indirect manner, from fusion R&D that was ongoing in that period 20 years ago. Similarly, in an indirect way, it led to the growth of two successful businesses. It is this latter connection—between having an interesting piece of technology and creating a successful business—that is the real message of this talk. Fusion Systems Corporation's history may illuminate some of the subtleties of this linkage and be useful to potential entrepreneurs as well as public policymakers.

[1] Fusion Systems Corporation®, 7600 Standish Place, Rockville, Maryland 20855-2798.

(Purchased by Eaton Corp for $300M in 1997)

United States Patent [19]
Ury

[11] **4,359,668**
[45] **Nov. 16, 1982**

[54] **METHOD AND APPARATUS FOR IGNITING ELECTRODELESS DISCHARGE LAMP**

[75] Inventor: **Michael G. Ury**, Bethesda, Md.

[73] Assignee: **Fusion Systems Corporation**, Rockville, Md.

[21] Appl. No.: **283,701**

[22] Filed: **Jul. 15, 1981**

Related U.S. Application Data

[63] Continuation of Ser. No. 20,457, Mar. 14, 1979.

[51] **Int. Cl.**[3] **H01J 7/46; H01J 19/80**

[52] **U.S. Cl.** ..... **315/39;** 250/372; 250/504 R; 315/267; 315/248; 315/344

[58] **Field of Search** 315/39, 248, 267, 344; 313/54; 250/372, 373, 504

[56] **References Cited**

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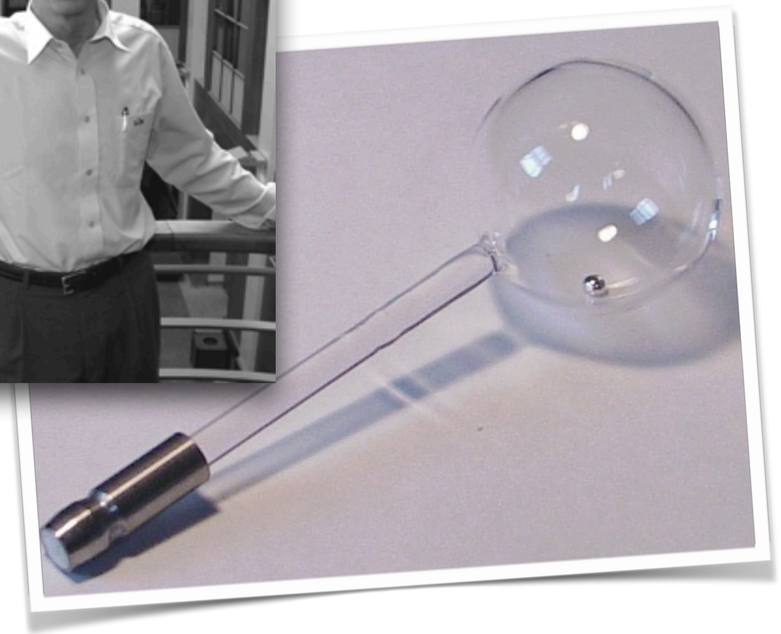
Primary Examiner—Saxfield Chatmon, Jr.
Attorney, Agent, or Firm—Pollock, Vande Sande & Priddy

[57] **ABSTRACT**

A method and apparatus for igniting a microwave generated discharge lamp. An ultraviolet-producing means is positioned so as to irradiate the fill-containing envelope of the discharge lamp. The ultraviolet-producing means is excited by microwave energy which is extracted from means which couples microwave energy from the microwave source to the fill-containing envelope of the discharge lamp.

9 Claims, 1 Drawing Figure



US005252499A

United States Patent [19]

Rothschild

[11] **Patent Number: 5,252,499**

[45] **Date of Patent: Oct. 12, 1993**

[54] **WIDE BAND-GAP SEMICONDUCTORS HAVING LOW BIPOLAR RESISTIVITY AND METHOD OF FORMATION**

[76] Inventor: **G. F. Neumark Rothschild**, 153 Old Colony Rd., Hartsdale, N.Y. 10530

[21] Appl. No.: **232,405**

[22] Filed: **Aug. 15, 1988**

[51] **Int. Cl.**[5] **H01L 21/265**

[52] **U.S. Cl.** **437/22**; 437/24; 437/937; 148/DIG. 69; 148/DIG. 84

[58] **Field of Search** ..... 437/937, 22, 24; 148/DIG. 69, DIG. 84

[56] **References Cited**

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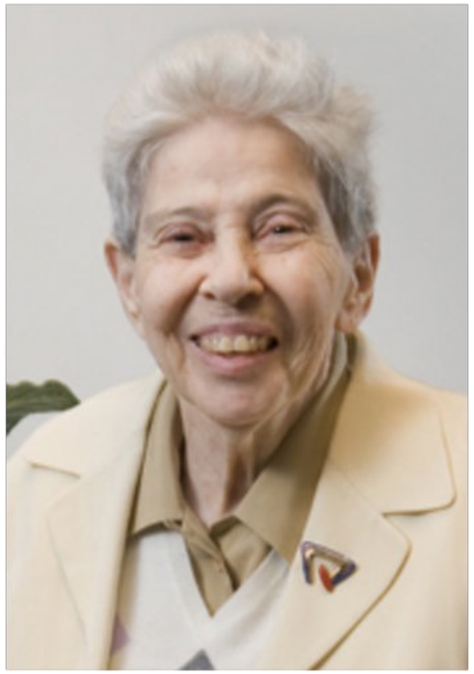
(List continued on next pag...

Primary Examiner—Robert Kunemund
Assistant Examiner—Ourmazd S. Ojan
Attorney, Agent, or Firm—Blum Kaplan

[57] **ABSTRACT**

A wide band-gap semiconductor, such a... conductor having low bipolar resistivity...



The Nobel Prize in Physics 2014

© Nobel Media AB. Photo: A. Mahmoud

Isamu Akasaki

Prize share: 1/3

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Hiroshi Amano

Prize share: 1/3

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Shuji Nakamura

Prize share: 1/3

DESIGNLINES | INDUSTRIAL CONTROL DESIGNLINE

MKS acquires ASTeX for $300 million

MKS acquires ASTeX for $300 million

By EE Times, 10.02.00 0

ANDOVER, Mass. -- MKS Instruments Inc. here today announced that it has entered into a definit agreement to acquire Applied Science and Technology Inc. (ASTeX), a supplier of sputtering equip and other products, for $300 million in stock.

With the acquisition of ASTeX, based in Wilmington, Mass., MKS will gain a quick entry into the sputtering equipment, gas generator, RF and microwave power source, and other gas-reactive systems markets.

It will also give customers a one-stop shop of products in these markets. ASTeX makes subsystems and sputtering tools for the semiconductor industry, while MKS is a leading supplier of process control instruments for OEMs, such as Applied Materials Inc. and other equipment makers.

""After getting a BS in Eng. Physics from UC Berkeley, I taught physics and physics education in Bogota, Colombia, as a Peace Corps Volunteer. Afterwards, I went to Columbia University for PhD in Applied Physics focusing on plasmas...."

Great balls of fire

Three startup fusion companies are challenging ITER, an over-budget and overdue public project.

NAME	LOCATION	TECHNOLOGY	STAFF	FUNDING	STATUS	TARGET TEMPERATURE
Tokamak Energy	Milton, U.K.	Spherical tokamak	35	$25 million	New ST40 device in 2017	100 million degrees Celsius
Tri Alpha Energy	Foothill Ranch, California	Beam-driven plasma rings	160	>$500 million	New C-2W device in 2017	30 million degrees Celsius
General Fusion	Burnaby, Canada	Target implosion	65	>$75 million	Prototype in 3–5 years	100 million degrees Celsius
ITER	Cadarache, France	Tokamak	2300	$20 billion	Under construction. First plasma in 2025	150 million degrees Celsius

ENERGY

Private fusion machines aim to beat massive global effort

Startups avoid ITER's path with new prototype reactors

By **Daniel Clery**

When finally complete in 2025, the $20 billion fusion reactor called ITER, rising near Cadarache in France, will be seven stories tall. Even then, nothing guarantees that it can hold nuclei together at temperatures of 150 million degrees Celsius, inducing them to fuse and release energy. Now, a small U.K. company has unveiled a 2-meter-tall chamber that looks like an oversized beer keg and cost about £10 million to develop. Using a different reactor shape than ITER and, eventually, superconducting magnets, the company says it has a cheaper and faster and welcome the competition. "Fusion is too important for one approach or one device," says Dennis Whyte, director of the Plasma Science and Fusion Center at the Massachusetts Institute of Technology in Cambridge.

Since the 1960s, one shape has dominated fusion: the tokamak, a ring-shaped vessel for containing plasma, the ionized gas that must be heated to more than 100 million degrees Celsius to achieve fusion. Powerful magnets around the tokamak create fields that not only keep the plasma from damaging the interior surfaces, but also compress and heat it. Yet scientists have struggled to keep the plasma stable and hot enough for a fusion reaction that produces excess energy. Because

ENERGY

MIT renews push for fusion energy

Collaboration with company aims to feed grid in 15 years.

BY JEFF TOLLEFSON

The Massachusetts Institute of Technology (MIT) in Cambridge will work with a private firm to develop technology for producing energy from nuclear fusion within the next 15 years. If successful, the multimillion-dollar effort could help to unlock a virtually limitless source of pollution-free energy.

The approach — which has so far attracted US$50 million — is based on high-temperature superconductors that have become commercially available in the past few years, the team announced on 8 March. The new generation of superconductors will allow researchers from MIT and Commonwealth Fusion Systems (CFS) in Cambridge to strengthen the magnetic field that contains the hot-plasma fuel used in conventional tokamak reactors. That could pave the way for reactors that are smaller, cheaper and easier to build than those based on previous designs — including the international ITER project under development in southern France, which is over budget and behind schedule.

"It's about scale, and it's about speed," says Robert Mumgaard, chief executive of CFS. The company — an MIT spin-off — has attracted $50 million from Italian energy giant ENI, and plans to invest $30 million of that sum in research and development at MIT over the next three years. Mumgaard says that the collaboration between academics and industrialists should help to drive fusion technology out of the lab and into the marketplace.

Fusing hydrogen atoms to form helium releases massive amounts of energy, which can be harnessed to produce carbon-free electricity. But sustaining the extreme temperatures that are required for this process in a confined space remains a daunting challenge that has defied most hopes and expectations to date.

CFS is the latest in a series of companies pursuing fusion energy as a clean-power source. Tokamak Energy, a company based near Oxford, UK, is also developing a tokamak reactor using high-temperature superconductors. But observers say that the MIT initiative is the most significant of its kind.

"There are no guarantees," says Stephen Dean, who heads Fusion Power Associates, an advocacy group in Gaithersburg, Maryland. But "if MIT can do what they are saying — and I have no reason to think that they

NEWS

Get Started - Intrapreneurship and Experiential Learning

NEWS

Get Started - Entrepreneurship

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Our Design Studio offers courses, programs, studio hours and events that help the Columbia community get unstuck an…
https://t.co/zwUbh5IJiN

SEP
4

FEATURED EVENT

Columbia Entrepreneurship Design Studio Open House

6:00pm – 7:30pm

APPH E4901 & E4903 Ap http://sites.apam.columbia.edu/courses/apph4903x/

Fall 2018 Theme: Entrepreneurship in Applied Physics and Starting a Tech Start-Up

Email: *mauel@columbia.edu*

General

Welcome to the APPH E4901 & E4903 *Applied Physics Seminar* class information site.

Most Wednesdays from 11:40 AM to 12:55 PM in Room 401 Chandler. *Chandler is located in the Chemistry Building Complex on the east side of Broadway.*

APPH E4901x *Applied Physics Seminar* 1 pt. Discussion of specific and self-contained problems in areas such as applied EM, physics of solids, and plasma physics. Topics change yearly. This course is usually reserved for third-year students majoring in Applied Physics.

APPH E4903x *Applied Physics Seminar* 2 pt. Involves students in all of the discussions that are part of **APPH E3401**, but also involves the preparation of a formal term paper or presentation on a research topic of the student's choice. This course is usually reserved for graduating seniors majoring in Applied Physics.

Topics change every year and are designed to introduce students in to current research in applied physics.

Theme

This year's themes are Entrepreneurship and High-Tech Startups.

The importance of applied physics in advancing commercialized products and starting business was featured in the November 2014 issue of Physics World. This year also coincided with the Nobel Prize in Physics being awarded to Isamu Akasaki, Hiroshi Amano and Shuji Nakamura "for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources." These technology advancements drove rapid commercialization

Columbia Fast Pitch Competition 2019

http://entrepreneurship.columbia.edu/event/columbia-fast-pitch-competition-2019/

NOV
21

5:30 pm - 8:30 pm

REGISTER NOW

OPEN TO ALL COLUMBIANS (Including Teachers College and Barnard)

APPLY HERE

Come watch Columbia Engineering's Fast Pitch Competition!

We're starting competition season again with Fast Pitch on **November 21**. Watch the competitors pitch their ideas in 60 seconds in front of a live panel of judges.

Fast and furious, Fast Pitch is Columbia's elevator pitch competition. Teams must sell their customers and our judges in 60 seconds or less. Winning teams will be judged to be the most concise, complete, and compelling. Attendance is free, the experience is priceless. If you'd like to watch, and possibly find a founder, co-founder, or team member, just register.

Perfect Your Elevator Pitch

- **An “elevator” pitch is intended to be a concise, compelling introduction to your business. You should be able to slightly modify your elevator pitch depending on whether you are pitching to prospective investors, customers, employees, or partners.**
- Here are a few tips for developing and delivering a great elevator pitch:
  - Start out strong.
  - Be positive and enthusiastic in your delivery.
  - Remember that practice makes perfect.
  - Keep it to 60 seconds in length.
  - Avoid using industry jargon.
  - Convey why your business is unique.
  - Pitch the problem you are solving.
  - Invite participation or interruption by the listener—this shows they are interested and engaged.

Our Plan

- Learn from the experiences and advice from other applied physics entrepreneurs
- Be creative (inventive!)
- Discuss and learn together as a class
- Select one or more “business plans” to pitch