Toyonaka, Osaka Prefecture: School of Engineering Science, Osaka University

PHOTO

1. Characteristics of the fire

Silane gas, used as a material in the fabrication of integrated circuits (ICs), spontaneously combusted during IC fabrication experiments within a laboratory within the School of Engineering Science, Osaka University. Two students died and 5 were injured in the conflagration that followed. This incident called into question safety measures for university research facilities.

2. Overview of the fire outbreak

(1) Date and time of outbreak

Approximately 15:57, Thursday, October 2, 1991

(2) Detection

16:03, Thursday, October 2, 1991 (emergency call to fire department)

(3) Under control

17:37, Thursday, October 2, 1991

3. Overview of fire origin

(1) Location

1-1 Machikaneyama-cho, Toyonaka, Osaka Prefecture, Japan

(2) Building of fire origin

Room 518, Wing D, Electrical Engineering Department, School of Engineering Science, Osaka University

(3) Structure of building of fire origin, etc.

(1) Date of construction

1961 (month and day unclear)

(2) Additions/renovations

None

(3) Building utilization

College/university (Category 7)

(4) Building structure

Reinforced concrete, 5-story with partial 6th story (fire resistant)

(5) Area

Building area: 8,180 m^2

Floor area: 33,948 m^2

(6) Building capacity

The building has 489 rooms.

(7) Building occupancy (at time of outbreak)

It is unclear how many people were in the building at the time, although there seems to have been approximately 200–300 students.

(8) Area and utilization by floor

Floor	**Area**	**Utilization**
6	479.6m^2	Tower
5		Laboratories, Professors' offices
4		Laboratories, Professors' offices
3		Laboratories, Professors' offices
2		Laboratories, Professors' offices
1		Laboratories
Total		

(4) Firefighting equipment, etc.

(1) Firefighting equipment

Fire extinguishers, interior fire hydrants, private fire hydrants (attached to water main)

(2) Alarm devices

Automatic fire alarm, emergency broadcast system

(3) Evacuation facilities

Exit lights

(4) Other facilities necessary for firefighting

Fire hose station

(5) Fire prevention system

(1) Fire prevention officer

Appointed April 16, 1990

(2) Fire prevention plan

Presented June 15, 1987

(3) Fire drills

Fire drills were conducted once a year. Furthermore, a report of an inspection of firefighting facilities, etc., was presented February 26, 1991.

4. Weather conditions

(1) Weather

Cloudy

(2) Wind direction, speed

Northwesterly, speed 4.0m/s

(3) Temperature, humidity

Temperature: 24.7ºC, humidity: 46.0%

(4) Weather warnings, bulletins, etc.

None

5. Cause of fire

(1) Ignition source

Silane gas

(2) Route

For some reason, silane gas within a cylinder underwent a violent oxidation reaction, whereupon reaction products escaped from the cylinder.

(3) Ignited substance

Silane gas undergoing spontaneous combustion

6. Fire damage

(1) People

(1) Fatalities

2 (2 males)

(2) Injuries

5 (5 males)

(2) Property

(1) Building where the fire emerged

a. Extent of fire loss

Partial loss

b. Area of fire loss

199 m^2 (5th floor laboratory: 49 m^2; 2 adjacent laboratories: 150 m^2)

c. Monetary loss

117,269,000 yen

(2) Other buildings

None

7. Fire route (progression)

(1) Overview of outbreak location

The fire occurred in Room 518, a room in Wing D partitioned into 3 laboratories (sections). Within

the room, 5 researchers/assistants/students were conducting experiments, etc. Two were within the section of the explosion. Three were within another section of the room.

(2) Situation up to the outbreak

It is unclear whether the explosion occurred during an experiment or after one. It appears that silane gas within a cylinder underwent a violent chemical reaction for some reason and, by that, exploded.

(3) Progression up to fire detection

The accident was immediately noticeable by the sound of an explosion.

(4) Notification of fire department

The first notification came from the Osaka University School of Science, located 50 m to the south of the site. It was to the effect that "There was an explosion in a laboratory, which is now burning — 5th floor of the Engineering Science building."

From that time up to about 16:10, 11 emergency calls concerning the incident were made to the fire department.

(5) Initial firefighting attempts

An internal firefighting unit did unroll a hose from an interior fire hydrant, but it is unclear if initial firefighting activities (water spraying) were carried out.

(6) Fire spread

The fire spread instantaneously with the explosion.

(7) Evacuation

There were approximately 200–300 students in the building at the time, and they escaped on their

own. In addition, 3 of the 5 injured also escaped on their own.

(8) Fatalities

Five people were in room 518 when the fire broke out. As mentioned earlier, that room had been partitioned into 3 sections. Two people were in the section of the explosion, and, unable to escape, they died, presumably of burns.

8. Activities of firefighting units

(1)Dispatched units, etc.

(1) Dispatched vehicles: 32 (on station), 1 (emergency assignment), 1 (assistance dispatch)

(2) Dispatched personnel: 89 (on station), 10 (emergency assignment), 5 (assistance assignment)

(2) Firefighting and rescue activities

(1) Firefighting activities

Firefighters entered the building under a protective water spray provided by 2 units. It was exceedingly difficult to approach the room of the fire, however, because of heavy smoke and heat, together with the obstacles represented by a scattering of test equipment, high-pressure gas cylinders, and other debris from the explosion throughout the hallway and within the room itself.

Firefighters, being told that the laboratory is fundamentally a chemical laboratory and thus contains high-pressure gases, toxic gases, and other such substances, had no choice but to be cautious in their firefighting efforts.

Because heavy smoke already filled the floors from the 4th upward, firefighters donned respirators and, from the 5th-floor rooftop on the west side, helped evacuate students from the floor of the fire. Then, under a protective water spray, they advanced from that area toward the room of the fire. High-pressure gas cylinders scattered around the hallway presented a risk of ignition by radiative heat, and thus the firefighters, after cooling the cylinders with water spray and confirming their soundness, carried them away. Taking care to avoid injury, they next worked their way from the west toward the room.

A subsequent search by rescue unit members, etc., resulted in the discovery of 2 bodies within the room. The time of discovery was 17:33.

9. Problems, lessons

(1) It is necessary to consider approaches to collecting information relating to substances, etc., handled within laboratories, etc.

In engineering school laboratory contains a variety of dangerous substances, which necessarily restricts firefighting activities. Here, it is necessary for fire department to direct university officials to create a system for collecting such information.

(2) It is necessary to establish safety control systems for dangerous substances at laboratories, etc.

Substances classified as dangerous under fire-related laws are stored within legally compliant indoor storage rooms. However, these substances are subdivided into small portions for use within experiments and research, and furthermore many types of high-pressure gas and similar substances not covered by the fire code are also in wide use. On a similar note, research and experimentation facilities utilized for the development of state-of-the-art technologies necessarily contain numerous substances that are difficult to classify one way or the other. This all points to a need to reinforce

safety and security systems at colleges and universities.

10. Documents

10.Materials

Figure 1: Map: Toyonaka campus of Osaka University

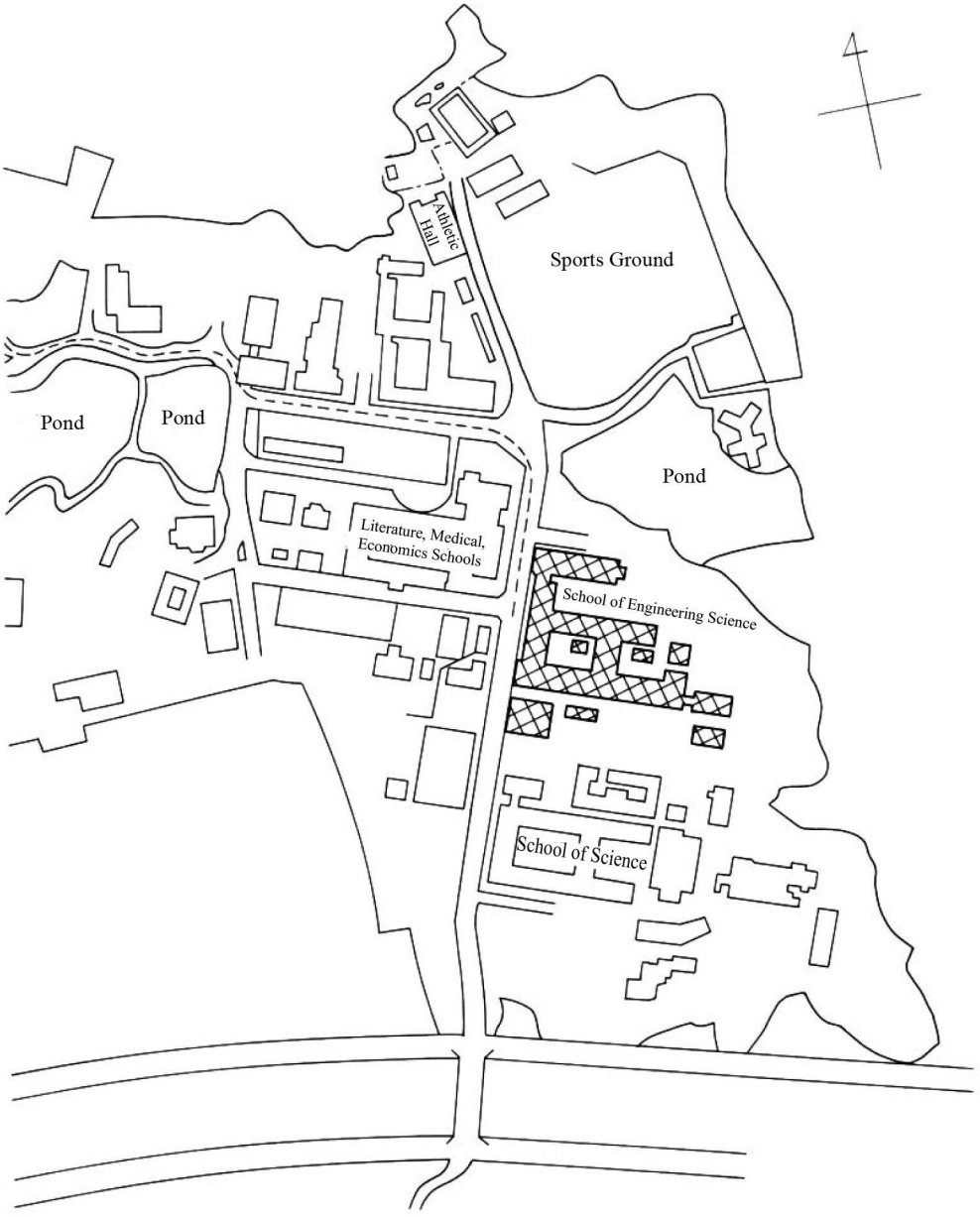

Figure 2: Laboratory floorplan